Australian Aboriginal Virtual Heritage

A philosophical and technical foundation for using new media hardware and software technologies to preserve, protect and present Aboriginal cultural heritage and knowledge.

Protecting, preserving and promoting Aboriginal arts, cultures, heritage and knowledge using 3D virtual technologies.

Submitted in fulfilment of the requirements for the degree of Master of Arts (Research), Creative Industries Faculty, Queensland University of Technology, 2014

Image 1 - This virtual screen shot is from Vincent's World and represents a re-create of a view and path (Songline) around the base of the Tombs in the Mt Moffatt Section of Carnarvon Gorge.

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Australia, Aboriginal Australia, Aboriginal Virtual Heritage, Aboriginal Digital Heritage, Indigenous history, arts and culture, virtual technologies, virtual reality, digital knowledge management, virtual culture, digital culture, digital mapping, spatial knowledge management, spatial systems

Abstract

Cultural knowledge is a central tenant of identity for Aboriginal people and it is vitally important that the preservation of heritage values happens. Digital Songlines is a project that seeks to achieve this and was initiated as a way to develop the tools for recording cultural heritage knowledge in a 3D virtual environment. Following the delivery of a number of pilots the plan is to develop the software as a tool and creative process that anyone can use to record tangible and intangible natural and cultural heritage knowledge and to record the special significance of this knowledge as determined by the traditional owners.

Digital Songlines is a product and a service for preserving aboriginal knowledge as a virtual heritage environment. This innovative project has the potential to assist decision making for the management of cultural heritage and the mitigation of damage to its precious heritage values for future generations.

The product aspect is that of a software toolkit for rapid prototyping of natural and developed heritage, including its values within a defined geo-spatially area. The service is also a process for assisting the documentation, designing and creation of interrogative virtual heritage environments. The product seeks to assist communities to visualise those culturally significant landforms, objects, sites, fauna and flora as well as the represent the values, personal histories, geographic descriptions and other cultural related land-uses as determined significant by the traditional owners for a particular contested terrain.

Digital Songlines is developed from indie and open-source virtual software. It was developed in partnership of many where computer application for various purposes was 'mashed' together to support the enterprise of recording in real time, cultural heritage knowledge for the purpose of education, entertainment and ultimately to support arts, language and cultural heritage management.

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signed: QUT Verified Signature
Brett Leavy

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Uncle Vincent Serico
Uncle Jimmy South
Uncle Herb Wharton
Uncle David Carline
Uncle Tiga Bayles
Francis Kelly
Aunty Ysola
Aunty Pat O'Connor

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Prologue

This thesis is designed as a practice-based 60 percent creative practice and 40 percent exegetical work that is a compilation of theoretical, analytical and archival material based on the Digital Songlines project undertaken in the Creative Industries Faculty, QUT, over the course of this study. As a rich-text document, the exegesis is made up of an Introduction and Contextual Review that maps contemporary activity in the Indigenous cultural heritage cultural management sphere in Australia.

The practice component of the thesis includes the digital copies of the Songlines project: namely Vincent's World and Irene's World. This research is an interactive multimedia simulation of the heritage, knowledge, and connections between people, artefacts and land of Aboriginal Australia. The purpose of the project is to introduce a new research domain known as Australian Aboriginal Virtual Heritage. The exegetical section of the project investigates the relative benefits and advantages of using 3D simulation software tools and hardware for preserving and presenting Aboriginal culture and heritage for the purpose of Australian Aboriginal knowledge management. As such, the practice and exegesis represents an important contribution both in the field of interaction design and also to Indigenous studies in Australia.

Lastly, an appendix of archived conference papers and publications have been delivered or published jointly with the colleagues (named on the publications) in relation to this research.

Introduction: Mapping the Field

Australian Aboriginal Cultural Heritage Management is undergoing considerable change and adaptation as key stakeholders, governments and Aboriginal custodians strive to employ better systems, techniques and methodologies to protect, preserve and present Aboriginal knowledge. This paper attempts to explore best practice research and development practice and Internet Communication Technology (ICT) tools for the purpose of preserving Australian Aboriginal cultural heritage and knowledge for future generations to experience, learn, understand and respect.

Two hundred and twenty years ago, at the time of first settlement, the Australian continent boasted a very diverse and cultural rich and varied landscape with over six hundred Aboriginal tribal groups having survived and prospered for arguably sixty thousand years. According to the Federation of Aboriginal and Torres Strait Islander Languages Association (FATSIL), Aboriginal people across Australia spoke over two hundred and fifty different languages. The archives of AIATSIS possess research and information that shows that each cultural group had a distinct culture were custodian for a unique set of stories and passed this on through the generations via a rich and distinctive oral history and practice (AIATSIS). The term knowledge used in this paper refers to the collective knowledge of all Aboriginal groups as a means to respect the diversity of Aboriginal groups across Australia. This diversity and extensive nature is evidenced by the work of Horton in the compilation of the Horton Map that is published and distributed by Australian Institute for Aboriginal and Torres Strait Islander Studies (AIATSIS).These stories or songlines reinforce the close association of each tribal group to the land, its laws and cultural knowledge associated with the landscape and reinforced by custodial rights and practices which have ensured the ongoing survival of Aboriginal cultures throughout Australia for tens of thousands of years and can be shown by reference to carbon dating of rock art sites and associated evidence at such places as Quinkin Rock, Carnarvon Gorge, The Kimberley, Lake Mungo, Mootwingee and Lake Kowanyama.

Researchers over the life of the Institute have researched and argued that Australian Aboriginal culture and heritage is one of the oldest living and continuously surviving in the world. According to AIATSIS research conducted by and as accepted by the vast majority of

Aboriginal groups across Australia, Aboriginal knowledge has been passed, from generation to generation, through a complex tapestry of stories embodying interconnected narratives, myths, legends, songs, dances, artworks and rituals. Also, in the interviews contained in a book called Elders – Wisdom from Australia's Aboriginal Leaders. Significant Aboriginal people like Mandawuy Yunupingu, Yothu Yindi Leader and Australian of the Year in 2003 and Lowitja O'Donoghue, ex-chairperson of the Aboriginal and Torres Strait Islander Commission, state that their cultural heritage is also contained in artefacts, carvings, rock paintings, and passed along the trade routes and reinforces the connections of each tribal group to the land that they are custodians of and this can be collectively termed as Songlines.

As Rose wrote in 1992:
"We speak to the country, sing to it, visit country, worry about country, cry for country, and feel sorry for country. Some say the country knows, hears, smells, takes notice, takes care and is sorry or happy..."

In my lifelong study of Aboriginal culture, such connection is often taught to Aboriginal children by their extended families. It is explained at a very early age how unique and significant Aboriginal culture and heritage is and that significant knowledge is embodied and embedded in the landscape. In my travels over the last two decades, consulting with Aboriginal people through my various roles in Aboriginal Media and Communications, many have stated that the country sustains the tribal communities and is constantly interpreted through the perspectives about of the custodians who look to it for their survival and sustenance. AIATSIS researchers tend to define and deconstruct this complex interweave of knowledge, culture and heritage by representing it through studies in the language which transfers understanding of the landscape, flora and fauna, climate and cosmology. Researchers at AIATSIS have found that each generation transfer knowledge, as well as the responsibilities for cultural maintenance, to the next generation to ensure its survival and careful management as well as to support the maintenance of the natural resources so important to the longevity of the clan and its continued custodianship of their cultural heritage.

Contextual Review

This section of the project investigates which Internet Communication Technology (ICT) tools are best to use in this type of project, what is and where does cultural heritage exist, why is it important, how can Aboriginal cultural heritage be effectively preserved and what role do new media technologies play in this new domain.

Because of non-Aboriginal intervention and public policy determination, cultural heritage has become an important issue for the advancement of Australia in all industries. As such, the need arises to work within this context to address some of these questions, and in doing so a new discipline is evolving which contains processes, protocols, methodologies and ethical procedures that could facilitate the recording, preservation and promotion of Aboriginal knowledge.

Prior to first settlement and during the occupation of traditional Aboriginal lands, Aboriginal knowledge was recorded and preserved by oral tradition, passed on by word of mouth, art, trade and customary practice from generation to generation. With the advent of new media technology, cultural heritage can be captured through digital recordings and be stored in databases or published through a variety of other means, such as digital audio broadcasts like the National Indigenous Radio Service, books like Aboriginal Australia and the Macquarie Encyclopaedia of Indigenous Australia, journals, newspapers like the Koori Mail and in films and television produced and directed by Indigenous and non-Indigenous filmmakers like Rachel Perkins, Director of Radiance, Donna Ives, Director of Straight from the Yudaman's Mouth, Sam Watson, Director of Black Man Down and Francis Kelly, Director and Cameraman of Bush Mechanics. Produced fortnightly, the Koori Mail is distributed Australia-wide, providing news, views, advertisements and other material of interest to Aboriginal Australians and Australians. The newspaper has been published since 1991, and has grown to the point where it is recognised as 'The Voice of Aboriginal Australia'. Other publishing mechanisms are transient, such as radio broadcasts and newspapers, (but often archived), and other means more suited to long-term preservation, viewing and revision.

In the researching of Aboriginal knowledge management undertaken by United Nations and UNESCO and PPGIS Network, I would argue that a new discipline has been defined. This discipline consists of the guidelines, legal issues, protocols and methodologies including rights with respect to the processes for preserving, protecting and promoting Aboriginal cultural heritage using 3D interactive new media technologies. The legal issues however, still need to address the rights relating to the collection of Aboriginal knowledge, database and commercialisation rights, as well as licenses to other Aboriginal groups. But, such questions are beyond the scope of this thesis.

Early Inquiries

Research into the development of Aboriginal knowledge management started in the early 1990s as computer games and simulation technology began gaining momentum. The first international forum was the International Society for Virtual System and Multimedia (VSMM) which was borne out of research in Japan. I presented the concept of using ICT in Australian Aboriginal Cultural Heritage in a paper at the 4th International Conference on Virtual Systems and Multimedia in Gifu Japan. In the paper, titled CyberDreaming – Digitising the Cultural Landscape of Aboriginal Australia, the concept of recording Songlines using simulation technology was tabled following two years of research into the presentation and preservation of Aboriginal culture, heritage and language. This paper built upon my work with the Queensland and Northern Territory Cooperative Multimedia Centre (QANTM) and built upon the foundations of work occurring throughout Australia and internationally in new media technology and the expanding trends relating to the use of traditional media forms of film, print, radio and television for cultural heritage preservation, promotion and presentation.

CyberDreaming

Following the 1998 VSMM conference and presentation of the paper, I established CyberDreaming Pty Ltd for the purpose of providing new media services and products in the field of Australian Aboriginal arts, culture and the business community to explore how concepts and ideas presented in this research paper might be delivered through a multimedia service targeted towards Aboriginal communities needs across Australia. CyberDreaming won contracts with a number of Aboriginal community organisations across Australia to design and develop new media solutions. As a necessity, CyberDreaming

needed to build a reputation for following cultural protocols as part of its methodology for design and development of new media technology products and services for Aboriginal people.

During the formative stages of the company's delivery of products and services, it became apparent that, by adopting 3D new media software, whilst innovative and seemingly appropriate, was at this stage in the industry, expensive to achieve, time consuming to produce and thus difficult to adopt readily as a useful tool and method for documenting Aboriginal cultures and heritage. As a consequence, CyberDreaming maintained a simpler business strategy and focussed on the delivery of web, cd-rom and print media services which addressed 2D contexts for recording, preserving and presenting Aboriginal cultural heritage knowledge.

In 2003, CyberDreaming entered into the partnership with the Australasian Cooperative Research Centre for Interaction Design (ACID) based at the Creative Industries Faculty precinct at QUT. The central question for ACID's involvement in the question of Australian Aboriginal knowledge management related to an unproven application of game engine technology for this purpose of representing Aboriginal cultural heritage in virtual worlds. The suggestion at the time was that funds would need to be raised from government and an industry partners to support this research and AURAN as well as SGI were supportive in the first instance for a research project to explore the creation of this interactive virtual heritage software toolkit.

What is Australian Aboriginal Cultural Heritage?

According to Rose 1992, a Euralyroi person, Australian Aboriginal cultural heritage is sum total of living experience built up by communities and passed from one generation to the next and whose right to knowing is given by birth. Rose states further that Aboriginal Knowledge is the sum of interconnected rules of interpretation through which Aboriginal people understand, give meaning, perceive or interpret the environment in which they exist.

From my conversations, observations and teachings with and from Aboriginal Elders across Australia, Aboriginal communities keep their cultural heritage alive by passing their knowledge, arts, rituals and performances from one generation to another. Many of the Aboriginal leaders I have met argue that this knowledge is passed to the next generation

through speaking and teaching languages, cultural practice, narratives, songs, dances, artworks and rituals and through the very act of protecting cultural materials, sacred and significant sites, and objects.

Land at the Core

From my own cultural knowledge, conversations with relaqtions and elders of many communities that I have visited, it is clear that land is fundamental to the wellbeing of Aboriginal people. Their land is not just soil or rocks or minerals, but a whole environment that sustains and is sustained by the people practicing their culture. According to the AIATSIS researchers, the land is the core of all spirituality and this relationship and spirit is central to the issues that are important to Aboriginal people today. Image 2 shows a significant nature landform which is part of a pathway leading towards "The Tombs" in Carnarvon Gorge. Beyond its natural beauty is a deeper meaning and representation for the traditional owners and others who have been revealed to its secrets. Such a place hold spiritual significance due to the purpose and customary practices performed at this site.

Image 2 - Photographed at the Amphitheatre located in the Mt Moffatt section of Carnarvon Gorge. This natural basalt barrier was used by the local Aboriginal people to herd Kangaroo during the hunt. Today Carnarvon Gorge is a national park and much of the original rock art is under threat of decay through natural elements and vandalism.

Aboriginal Elders, Jimmy South, Ethel Munn, Wayne Wharton and Irene Ryder, say that each clan is custodian over their own territory from which they derived the natural resources that were employed in various ways to ensure their survival. Australia's Aboriginal people still practice semi-nomadic hunting and gathering in places where the traditional lands are defined by geographic as well as spiritual boundaries that included rivers, lakes and

mountains. Within certain constraints Aboriginal Custodians still care for, in various ways. Their custodial environment and work towards their clan's practices for caring for country that leads to cultural heritage survival.

From conversations I have had with bush tucker experts like Irene Ryder, a Gunggari woman, Margaret Islen, a Quandamooka woman and Jennifer Isaacs, they argue that Aboriginal people cultivated the land in different ways than non-Aboriginal people, endeavouring to live with the land rather than live off it. Aboriginal people sought to preserve and not destroy the harvests of the land for it sustained their existence. Aboriginal knowledge of the land, is linked to their exceptional understanding of its uniqueness and these are most strongly represented in the hunter and gather lifestyle pursued by many Aboriginal people. Many pursuits involved hunting and tracking animals, identifying and locating edible plants and finding sources of water and fish population that could be sustainably harvested.

Diversity – Land and Languages

According to AIATSIS, Aborigines and Torres Strait Islanders identify themselves through their land, their relationship to others and their language and stories - which may be expressed through ceremony, the arts, family, religion, and even sport.
AIATSIS researchers, over decades of study, argue that there were around six hundred different clan groups or nations around the continent at the time of first settlement, many with distinctive cultures and beliefs. These territories where determined through a system of kinship which defined everyone's specific relationship, role and responsibility to each other as well special relationships with land areas based on their clan or kin.

Through my teaching and learning from elders, I have learnt that kinship influences marriage decisions and governs much of everyday behaviours which are essential to ensure survival. By adulthood, Australia's Aboriginal people knew exactly how to behave, and in what manner, to all other people around them as well as in respect to specific land areas. Kinship is about meeting the obligations of one's clan, and forms part of Aboriginal Law, sometimes known as the Dreaming.

FATSIL (2003) argues that language is vitally important in understanding Aboriginal heritage, as much of their history is an oral history. Hundreds of languages and dialects

existed (although many are now extinct), and language meaning, as well as geographic location, is used today to identify different groups.

Adaptation - Tools and Technology

Museums Australia (2001) argue that cultural heritage is defined by the tools and implements used by Aboriginal communities and is reflected in the geographical location of different groups. This is why the Museum works so hard to present the tangible heritage aspects in the manner and fashion that they have. As an example, they recognized that coastal tribes used fishbone to tip their spear weapons, whereas desert tribes used stone tips. We know this because this information is presented and interpreted in the open sections of the Queensland Museum, which Trish Banard, the Aboriginal curator who manages this, has adopted a methodology for Aboriginal exhibits and oversees its interpretative style. Her program at the Museum seeks to establish relationships with the Aboriginal Community, to allow and through this assist the Museum manage the interpretation of Aboriginal artifacts, assist the Museum respectfully present the tools, technologies and material cultures which represent each group and their material culture. This usually includes boomerangs, spears, woven artifacts, knives, digging sticks scrapers, axe-heads, shields, woomeras and various other vessels for eating and drinking.

Performance - Music, Songs, Dance and Ceremony

From conversations I have had with Aboriginal elders, curators and community leaders, ceremonial performances are seen as the core of cultural life and such performances bring together all aspects of their art - song, dance, body decoration, sculpture and painting. Music, song and dance was and is still today a very important part of Aboriginal life and customs.

Songs and dances are exchanged at large ceremonial gatherings where many people gather together and trade goods. In the past, these gatherings occurred at a time and place when food was in plentiful supply.

At the Laura Dance Festival, dance is represented as a unique aspect of ceremonies which is learnt and passed down from one generation to another. The modern festival adopts a traditional approach to presenting Aboriginal dance to the present generation to represent

knowledge, myths and stories of ancestral heroes. At Laura most often the youth are the performers to keep the stories alive.

At festivals like the Laura Dance Festival and arts and cultural organisations like Sydney's Aboriginal dance company, Bangara allow professional performers and certain groups of Aboriginal people to demonstrate their clan rights to mainstream audiences. Dance can also be seen as an occasion to entertain and to be entertained and through the work of dance, show their affinity to families and kin. It is for this reason that dance is often performed at the end of every day in many traditional and contemporary communities.

As Burra 2001 describes in The Spirit of the Night Sky, Australian Aborigines live in a harsh and fragile environment and, as a nomadic people, travelled from place to place following the patterns and signs in the land and in the stars. Burra believed the culture is so important and fragile that it has to be documented in books, texts, films and archives. The Queensland Government presently is managing and expanding a register called the Queensland Cultural Heritage Register, governed by the Aboriginal Cultural Heritage Act 2003, which assists with the preservation and protection of traditional knowledge as permanent physical records, recording of stories and oral traditions and proof of custodianship of the land.

As further advances in internet communication technologies and internet bandwidth occur, arguably more people in the general community will come to adopt Internet Communication Technologies and participate in the interconnected digital domain. It is important for Aboriginal people to adapt as well, as they have always done so in the past, and develop the means, access this technology and create user friendly software systems to present, preserve and protect their tangible and intangible cultural heritage. According to the Public Participatory Geographic Information Systems (PPGIS) web forums, ICT technologies can be designed and created to provide a better means for Aboriginal knowledge management. Such software tools could assist future generations better understand, be engaged, entertained and as such be provided with an innovative and encompassing means for preserving and protecting Aboriginal knowledge. It is argued by the Department of Information, Technology and the Arts that the internet can reach audiences, not just the remote, rural and regional places where Aboriginal people live, but also provide an important tool to connect these communities with the global information economy.

Digital Songlines: Research Analysis

The ACID project noted above sought to research better ways for people to interact with each other using communication technologies and their expertise lies in helping people participate in the digital world. ACID (now disbanded) was comprised of researchers who work in interaction design and includes professional design consultants, academics, researchers, post-graduate students, post-doctoral fellows, commercialisation experts, and industry collaborators and conducts research in interaction design and user experience design activities across five foundation projects:

1. *Suburban Communities*
2. *Creative Communities*
3. *Virtual Communities*
4. *Aboriginal communities*
5. *Beyond :30 seconds: new models of television advertising*

In all, research outcomes underpinned the design R&D services they offered to partners and clients.

In August 2003, ACID accepted the CyberDreaming proposal to conduct research in Aboriginal knowledge management. The main aim of the project was to research innovative approaches, define the protocols, methodologies and develop a toolkit to facilitate the collection, education and sharing of Aboriginal cultural heritage and knowledge. In following an iterative software development methodology the project developed a rudimentary toolkit to refine the ways that Aboriginal knowledge could be managed.

From September 2003 to June 2007, the Virtual Heritage Program and the Indigenous Communities project of ACID advanced the Digital Songlines Engine (DSE) and associated socio-cultural research. Content was collected and integrated into the software gathered from multiple media formats (oral histories, film clips, photographs, written knowledge, language, activities, dance etc).

What ACID argued was that in this domain, as defined by their published writing and a qualitative research approach, was an investigative model that relates to the efficacies of a game engine interface to communicate Aboriginal cultural heritage knowledge.

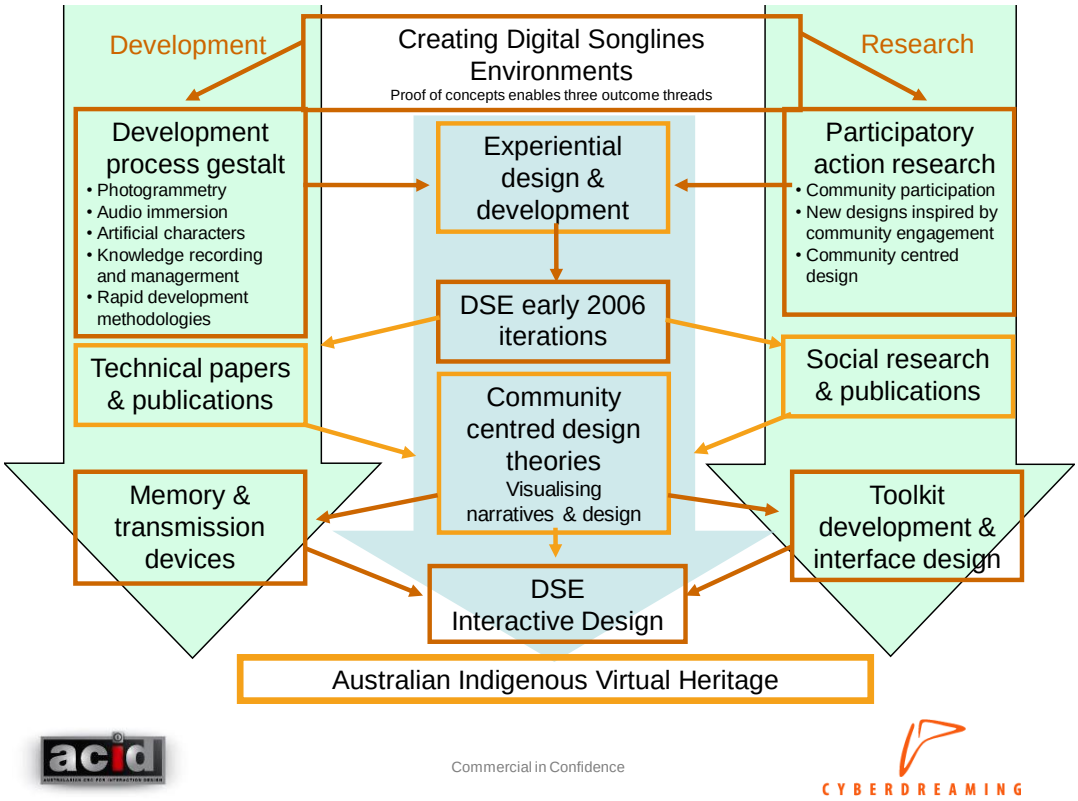

Figure 1 - The diagram explains the Australian Aboriginal Virtual Heritage process of design and development and encapsulates the research program undertaken by ACID in the creation of holistic and interconnected virtual worlds where embedded knowledge learned through observation, initiation oral history is learnt by looking and copying. The Aboriginal person acquires knowledge through trial and error – role play, learning through practice in (virtual) world. These principles are applied for the learner to gain context-specific skills, versus generalised principles: learning skills for specific tasks – cultural survival rather than learning general principles. First person orientation and focus on people and their relationships to information and the landscape is where DSE embodies interaction design principles ubiquitous, context-aware and tangible design theories to articulate reaction to concepts of user in preference to the concept of a player – the participant is the performer – holistic, connected and human centred in terms of knowledge transfer.

However I would suggest that a different and more cyclic model could suffice which more holistically fits the empowerment of the community most efficiently.

In the PPGIS forum and from research into the work for the VSMM and Virtual Heritage Network, the potential for simulation technologies and 3D simulation technologies, like game engines, showed this technology as a viable tool for Aboriginal cultural heritage management. These developing technologies present a new means for presenting cultures and heritages in new and innovative ways. 3D virtual world software tools for the creation of virtual space can be seen as an important tool for re-presenting historical, cultural, and sociologically significant places, infrastructure, artefacts, and the stories associated with Aboriginal knowledge.

The DSE implementation for Australian Aboriginal cultural heritage management differs from other simulation environments like flight, war, urban or architectural in that the very nature of the simulation is that the landscape is an important metaphor. The reason for DSE's focus on the geographical terrain is that the country is considered the most significant artefact and is vital importance to the spiritual connection of Aboriginal people to the land. For Aboriginal people the collective identity, authenticity and context is vital and DSE seeks to recognise this and provide a highly contextualised virtual system where the stories associated with significant objects can be represented authentically and sensitively.

Case Study: CyberDreaming and Beyond

I formulated the original idea for documenting Aboriginal Knowledge using Internet Communications Technology around 1994. The Indiginet was a program as an initiative developed in partnership with the Queensland and Northern Territory Multimedia Association (QANTM) borne out of a discussion of the potential of 3D digital technologies for presenting Aboriginal Dreamtime stories. In 1997, I became whilst Program Manager for the Indiginet Program with QANTM and later in 1998, I delivered a paper at the International Conference for Virtual Systems and Multimedia in Japan titled CyberDreaming – a new technology for an Ancient Culture. On my return to Australia, after international support critical approval for the idea of recording traditional cultural heritage knowledge about sites and significance of Carnarvon Gorge using new media technology, I established a company called CyberDreaming and began trading as a business. As Managing Director of CyberDreaming, I became an industry colleague with Professor Jeff Jones and together we explored the potential of realising this idea and led to my association and industry member partnership with the Australasian CRC for Interaction Design in 2001.

My formal association with ACID began in 2004, following my draft and acceptance of a set of Aboriginal Protocols for the collection, engagement and recording of Indigenous cultural heritage knowledge. Being of Aboriginal decent and being keenly aware of the sensitivities associated with cultural heritage knowledge, my particular contribution to the program was the engagement with community champions. Through my community connections this led to Irene's World and Vincent's World as projects.

I based the cultural heritage content to be recorded in this manner upon the Queensland Aboriginal Cultural Heritage Act 2004. I also identified a manner and process for recording cultural heritage knowledge using 3D virtual world technologies. Initially one of the partners, Auran offered their game engine but with the caveat that they do the work. I took the project in a new direction by jettisoning this software and process and selecting a game development tool called the Torque Game Engine from the indie game development company called Garage Games. By doing this I kept true to the principle that allowed the community to maintain ownership and control of their cultural heritage knowledge.

With the assistance of James Hills, I argued that ACID should embark, in the first part, upon developing a number of pilot projects using this software in partnership with a select few community champions. This strategy was adopted and the first community champion was Aunty Irene Ryder, a Gungarri woman from Mitchell in south west Queensland. I selected Irene because of her extensive work history of a number of decades in the area of Aboriginal languages and her extensive knowledge of bush foods and medicines in her traditional country.

My direct responsibility was to manage this engagement, select the appropriate traditional knowledge to be included in this 3D display and direct, on a daily basis, two and later three research assistants as they worked with task and responsibility of creating all the static and dynamic 3D models. In managing this project on a daily basis, I was able to ensure the integrity of the cultural heritage knowledge and sensitivities of Irene Ryder and her knowledge was protected.

During the course of the pilot's construction, I gave numerous demonstrations to the Board and visitors at ACID headquarters. To many observers, this project was very interesting and something worthy of academic evaluation. As the director and industry partner for the program, following an ACID Board Meeting where the guidelines for the CRC program were reviewed, I decided that the program should publish our research findings. In 2005 I met Theodor Wyeld at the University of Queensland and he agreed that the research findings and community engagement strategy would make a robust series of publications, so he agreed to manage this aspect of the program. Following his decision, I presented Theodor with my working notes, past conference papers and ideas for the interrogative and interactive aspects of the virtual heritage environments and Theodor compiled this material into a series of papers which are contained in the Appendix of this thesis. All of these papers started out as concept notes and Theodor assisted me to fashion, edit and submit these to the relevant international conferences. All papers we submitted were accepted and subsequently members of the team, including myself spoke at a number of International conferences on the subject of Virtual Heritage.

With respect to my technical contributions to the various projects these include the initial prototyping of functionality of the software and the various mash-ups to extend this functionality. This included the inclusion of Complete Characters – a software development

tool for creation realistic 3D characters and requested by Irene following my demonstration of our project to date. I found a script for the flight of the boomerang and the latitude and longitude display. I also identified an AI script that added improved path finding functionality to the animated characters and animals. I also selected animals to be modelled based upon the initiation principles of the Gungarri People. For the purpose of realism I also demonstrated the potential of Speedtree RT as a vegetation modelling tools and this was subsequently incorporated into the application. My decisions on functionality were always premised on the principle of creating a rapid development toolkit that the community could use to create their own virtual cultural interactive landscapes.

Concluding Statements

In this thesis, I have attempted to outline how the DSE project and toolkit could support and assist the documentation of Australian Aboriginal Cultural heritage and in doing so establish a methodology and set the foundations for a new domain called Australian Aboriginal Virtual Heritage. What this domain incorporates is a set of processes, protocols, methodologies and ethics that are required to facilitate the recording, preservation and promotion of Aboriginal Knowledge and cultural heritage to ensure its protection, assist with its preservation and provide and means of presentation.

A number of papers published by the author set out the qualitative and quantitative framework for this discipline and it is argued that the adoption of such technologies are vital to the ongoing survival, protection and preservation of Aboriginal cultural heritage and the knowledge for future generations and define the philosophical and technical issues that exist in adopting this new media technology for the purpose it is intended.

What ACID has tried to prove through its research over the last few years is that a 3D visualization interaction design tool and appropriate culturally sensitive methodology could be integrated into a set of development processes as an effective means for the preservation, protection and presentation of Aboriginal knowledge. The key factor however is that appropriate protocols are adhered to when dealing with Aboriginal communities to ensure the effective engagement of Aboriginal people in the design and production process. Only then would communities feel confident that the work of researchers in digitizing their knowledge using DSE would respect and represent their knowledge in a respectful and authentic fashion.

In developing DSE to digitally document Australian Aboriginal Heritage, researchers need to adhere to International Conventions passed by UNESCO. UNESCO has negotiated a robust and applicable set of International standards that the Discipline should adopt to strengthen the protocols relating to the engagement with communities, the community driven design, development and publication process for the recording, preservation and presentation of Australian Aboriginal cultural heritage.

Collecting, storing and disseminating Aboriginal cultural heritage knowledge digitally have been identified by a number of projects around the world. Virtual heritage researchers, designers and producers like Lon Addison, Robert Stone, Yehuda Kalay, Maria from Italy and Sarah Kenderdine, have achieve defines particular techniques and procedures and define a type of international standards framework that could be adopted. These practitioners present International Case Studies like Angkor Wat, Ancient Greece, and the work of

As a framework and application, virtual heritage softwares have been applied to the recording of the Temples of Angkor, built by the Khmer civilization between 802 and 1220 AD, to represent one of humankind's most astonishing and enduring architectural achievements. Sarah Kenderdine explains that at Angkor the Khmer kings ruled over a vast domain that reached from Vietnam to China to the Bay of Bengal. It was important that the structures seen at Angkor today, more than 100 stone temples in all, can survive and the remains of a grand religious, social and administrative metropolis and other buildings - palaces, public buildings, and houses - were built of wood and since have decayed be preserved in some tangible fashion. Sarah Kenderdine's Virtual Room Project (VROOM), exhibited at the Melbourne Museum, shows how such new media technology can work successfully in representing heritage and culture. Supporting this further, the Massachusetts Institute of Technology (MIT), a private, Research University located in Cambridge, Massachusetts, has applied virtual heritage techniques to the recording of scientific and technological research quanta, by the use of the Bioware's Neverwinter Nights game engine to depict the American Civil War. Both are arguably exciting and successful exponents of interactive virtual heritage.

However the protocols surrounding the engagement of communities are vital as well. Authenticity is vital to the acceptance to the relevance and success of knowledge transferral of this virtual heritage medium. As important also is the method by which communities are engaged to provide information and allow access to Aboriginal cultural heritage knowledge. Following Aboriginal protocol is an essential and necessary ingredient if the design, development of any Australian Aboriginal Virtual Heritage application is to be successful and achieve its intended purpose.

DSE utilises content for the creation of a 3D virtual worlds about places, keeping places, cultural values, tangible and intangible heritage, stories, myths, legends and regional specific references to tribal groups and their relationships to country. This content covers specific items like art, rock paintings, artefacts, rituals, traditions and even knowledge about flora and fauna – its food use application or medicinal purposes. DSE provides a means for presenting cultural heritage including Aboriginal ways of representing and retelling their patterns of socialisation, teaching and learning about a place. Content involves the languages of a place and relates to all representations and connections to country like videos, photographs, artworks on canvas, oral histories, books and recordings in archives or museums.

Content includes the myths and legends that relate and describe relationships to country and the methods and places where these stories are told and re-told that respect the spirituality of Aboriginal people and their diversity across this country. So, in collecting this content and looking at ways to digitise this for future generations, DSE was found to be an appropriate platform for this purpose. DSE supports authentic 3D environments that users claim provide an authentic experience and one that reflects the spiritual connection of Aboriginal to the landscape. Users argued they subsequently learned something about Aboriginal cultural heritage from the more recent iteration and especially the Virtual Warrane exhibit.

By working with Aboriginal communities and community champions, DSE has shown that Australian Aboriginal virtual heritage are valuable tools that supports a participative, integrated and multifaceted methodology for creating virtual worlds and that a three dimensional representation of reality in a simulated sense could be a useful visual and interactive way and method for assisting Aboriginal communities ensure their knowledge are protected, preserved and promoted for future generations.

Archive of Publications

The following chapter contains all the published output from CyberDreaming's collaboration with ACID about the Australian Aboriginal Virtual heritage and the application of DSE for meeting this challenge. There have been two book chapters published, five iterations of the DSE software designed with a number of different and diverse communities and many publications presented in collaboration with researchers, research assistants and industry partners. This body of this research work is presented in this section.

Book Chapters

[1. Leavy, B] Dyson, L.E, Hendriks, M & Grant, S. 2007. Information Technology and Indigenous People: Information Science Publishing, USA.

Abstract
Digital Songlines is a software toolkit being developed by the Australian CRC for Interaction Design. It consists of an applied set of protocols, methodologies and a software program for the collection and sharing of Aboriginal cultural heritage knowledge. Regular consultations with Aboriginal traditional owners and representative groups are an essential component of the development process. This article provides an overview of the components of the Digital Songlines toolkit, and illustrates the development of the cultural heritage system in its current prototype. The system employs virtual reality tools to enable Aboriginal communities to digitally preserve, protect and promote their arts, culture and heritage; the 3D visualization will allow users to appreciate the lands as central to the culture, stories and lives of Aboriginal people and communities.

2. [Leavy, B.] Kalay, Yehuda, et al. 2007. New Heritage: New Media and Cultural Heritage: USA Press.

Abstract

Digital Songlines is an Australasian CRC for Interaction Design (ACID) project that is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of Aboriginal cultural heritage knowledge. This research will illustrate significant Australian Aboriginal spaces such as the Mt Moffatt area at Carnarvon Gorge in southwest Queensland and areas around the Pilbara in Western Australia. The project explores the areas of effective recording, content management and virtual reality delivery capabilities that are culturally sensitive and involve the Aboriginal custodians, leaders and communities in those areas as well as how players in a serious gaming sense can experience Aboriginal virtual heritage in a high fidelity fashion with culturally appropriate interface tools.

Demonstrations of the Digital Songlines Environment on PC / CD-ROMs

1. Leavy, B., Ryder, I., Hills, J., Carroll, J., & Brown, J., 2006. Digital Songlines – Irene's World: Explore Australian Indigenous Culture in a New Way. An Interactive and immersive 3D display of Aboriginal Arts and Culture: ACID, Australia. (A copy of this CD-ROM has been provided with this document.)

Irene's World was the first iteration using the Digital Songlines Engine. Irene's World represents the cultural heritage of the Gunggari people according to Irene Ryder. It is a 3D simulation that engages the user in a virtual world exploring the Australian Aboriginal Landscape through quests for knowledge about bush food, bush medicine, weapons and other items of cultural significance to the Gunggari people. Irene's World captures the flora and fauna, Gunggari affinity to the land and present oral histories and traditional memories about the landscape in an engaging virtual world. Irene's World is a simulation of Gunggari

Country near the Mitchell Township as recorded and retold by Irene Ryder a significant custodian of Gunggari Aboriginal cultural heritage and knowledge.

Before any formal development could take place in the creation and production of the first iteration of DSE called Irene's World, the author needed to follow a rigorous community engagement strategy. Irene's World was a DSE application which incorporated the arts, culture and heritage values of the Gunggari people who lived around Mitchell. The community engagement strategy that was followed involved the holding of a number of community meetings at locations including Canberra, Mitchell, Roma, Dalby, Beenleigh and Brisbane. At these meetings, members of the regional community attended and were demonstrated the early versions of the software, animations and community members discussed issues of dreamtime stories, authenticity, IP&C and other aspects relating to the interaction design of the 3D environment. Language workshops where also conducted relating to the stories and connection of the Gunggari people to the country surrounding Mitchell. The project was essentially overseen by Irene Ryder and the author was engaged as Creative Director. A team from ACID (define) which included the author travelled to Carnarvon Gorge and to Mt Moffatt specifically to photograph, capture audio, videoed and gather information which inspired the design and development of a virtual landscape – this was fundamental to the re-presentation of the real using the virtual for Irene's World. We used Qld Department of Lands arterial maps so that the scale and topography was accurate. The end product was a reproduction of the Mt Moffatt region with some of the Irene Ryder's stories. The end product allowed users to move through the curtain of time, mixed local stories, artefacts, and cultural icons to present Gunggari knowledge in a nonlinear and multilayered fashion as they were told (and sung) by Irene Ryder herself. Following the initial community engagement by the author the first reiteration using DSE resulted in a successful launch of the product in Mitchell in July 2004.

2. Leavy, B., Serico, V., Hills, J., Carroll, J., & Brown, J., 2006. Digital Songlines - Vincent's World: Explore Australian Indigenous in a New Way. An Interactive and immersive 3D display of Aboriginal Arts and Culture: ACID, Australia. (A copy of this CD-ROM has been provided with this document.)

Vincent's World was a 3D simulation that engages the user in an Aboriginal Art Virtual World that exploring the Australian Aboriginal Landscape through eyes of Vincent's Serico artistic interpretation. Vincent's art represents knowledge about bush food, bush medicine, animals, places, items of cultural significance to the Vincent and his life whilst he lived and worked around Carnarvon Gorge.

Vincent's World preserves the cultural heritage in an interactive virtual environment that is engaging as well as fun to navigate and explore. Traditionally the rich and diverse cultural heritage of Aboriginal people was passed on orally. Vincent's canvasses however are a rich tapestry of historical association at a time that presents the difficult co-existence of Aboriginal people and the white settlers. Vincent's World brings these concepts to life virtually to allow the user to explore such issue in a real-time knowledge based landscape.

Conference Papers

A Conversation on the Efficacies of the Game Engine to Address Notions of Sacred Space
The Digital Songlines Project and Transgressions of Sacredness.

Theodor G Wyeld[1,2], Patrick Crogan[3], Brett Leavy[2,4]

[1] Swinburne University of Technology,

[2]The Australasian CRC for Interaction Design (ACID)

[3]The University of Adelaide

[4]Cyberdreaming.

Abstract

The Digital Songlines (DSL) game engine is used as a vehicle for Indigenous Australian storytelling. Their storytelling is inextricably linked to the 'country' from which it emerges. The game engine provides a simulation of that country for embedding of the stories to be told. Much of the 'country' referred to is sacred. However, the fundamental underlying principles of three-dimensional reproduction of space in a 3D computer game (3DCG) define all spaces as mathematically equal – there is no place for notions of sacred spaces. This presents a dilemma for those cultures that do not subscribe to the scientific notions of ontological certainty underpinning such mathematically modelled space. In the case of the DSL game engine, notions of the sacredness of the country modelled has been made explicit in order to highlight its importance for its physical-world corollary. Hence, this paper discusses notions of sacredness and its place in the simulational spaces of the DSL's 3DCG engine. It presents a series of dilemmas for the inclusion of sacred places in simulational spaces. It does not attempt to resolve these dilemmas, but rather to bring them into sharp relief with examples drawn from the DSL project experience. In so doing, it presents a new way of thinking through the significance of this issue for Western and non-Western use of the 3DCG in cultural heritage applications.

Keywords: *Sacred Places, Sacredness, Uluru, Digital Songlines, 3D games, Cultural Heritage*

Introduction

3D Computer Game (3DCG) spatial simulation is unlike other forms of spatial simulation that are based on normative conventions of narrativised text – films, storybooks, theatre, and so on. 3DCG simulation introduces interactivity with the spatial narrative not possible in other genres [2, 13]. Spatial narratives – the interaction with, navigation of, and cognitive inhabitation in space – mean different things to different cultures. Space itself as a concept has been redefined in many different ways over time and by different cultures. For Western culture, space was once finite and divided between heaven and earth. Many spaces were considered sacred. Sacred spaces are those spaces that defy the logic of scientific definition, of quantifiable space, such as, the space of religious worship (churches, synagogues, temples, and so on); the space demarcated as a place of socio-cultural importance related to historical events; the homes of celebrities, and so on. Sacred spaces are controlled spaces. Access to and representation of these spaces and what they contain and what can be seen from them is often subject to rules and regulations. Different cultures may define their own sacred spaces in different ways but similarly feel the need to control how that space can be accessed and how it is represented. While physical sacred spaces can be controlled by physical means, the modelling of space by 3DCG that may include sacred spaces has introduced a new method for experimenting with notions of the sacredness of such spaces – from forensic reconstructions, the virtual entering of ancient tombs, to re-enactments of historical events. Experimentation with the notion of sacred space predates the 3DCG. Notions of the sacredness of space were profoundly altered for the West during the European Renaissance. In the Renaissance, previously conceived notions of the duality of body and soul, and their place in space, were dismantled by the emergence of Nicholas of Cusa's 'universal ideal' among other methodologically scientific shifts in thinking. Following this, all space was knowable, testable, mathematically quantifiable, and by implication, reproducible [7]. The 3DCG is the latest manifestation of the apparent reproducibility of space. Although the 3DCG is utilised in many different ways other than reconstructing sacred spaces, sacred spaces, as part of a pre-Renaissance culture, are constantly eroded by technological innovation thus raising questions about the basis of their sacredness. As such, it is a topic worthy of investigation.

This paper discusses the place of sacredness in a 3D computer game engine. More specifically, the appropriation of a 3DCG as a storytelling vehicle for the telling of Indigenous Australian stories which, by their very nature, include spaces that are sacred. As

such, they provide for the experimentation of notions of the sacredness of these spaces in a simulated environment. In turn, this presents a dilemma, as the opportunity for experimentation with these spaces in the context of a 3DCG is only possible as a product of the Western technological dismantling of notions of the sacredness of space. While this paper attempts to tease out the issues raised in these dilemmas, only a few can ever be addressed in full.

Simulational Spaces

3D computer game (3DCG) space provides a more active kind of participation with a virtual environment than the seemingly more controllable, passive participation with other media forms such as films, photography, theatre, storybook, and so on. 3DCGs are simulational spaces. They are different from these other conventional media forms, which are based on the reception and perception of existing narrativised texts; they are simulational spaces designed for interactivity [2, 13]. As such, users or, more precisely, 'inter-actors' can play out interactive narratives with simulated spaces with apparent impunity. Unlike in a film, photograph, theatre, storybook or other more conventionally received narrative, the game space allows new narratives to evolve through interaction with the space rather than the given narratives per se. For example, the interactor can experiment with a sacred space that might normally be censored from traditional media. That they are able to do this is a product of its underpinning technological ideology and faithful reconstruction of a universalised space, which includes sacred places as part of notions of holistic integrity which sees all spaces as equal in the modelling process.

Modelled space invites experimentation. As such, 3DCG simulational spaces are also spaces of the future [3]. They are about what can be done? with the spaces; experimental spaces; spaces for speculating on what ifs? In the Western sense of reducing reality to knowns, the spaces are simulations of the real. Within the scientific reductivist paradigm, experimentation does not raise questions of the sacredness of spaces. For, Western representations are abstractions of the real – metaphorically: this as that. However, for many cultures, abstraction and reality, subject and object, are often merged. Not all cultures subscribe to the Western scientific paradigm. Hence, representation may not be abstract. It may be more like re-presentation of the real. In this sense, the simulated spaces can be as sacred as their physical-world corollaries. This raises questions about how such spaces can retain their sacredness when re-presented in a 3DCG simulational space.

Transgressions of Sacredness in Simulational Space

Along with 3DCGs, Second Life [http://secondlife.com] is a simulational space experiment. As a massive multiuser platform with millions of users, and ostensibly a simulated 'other-world' social experiment, there are many opportunities to test notions of sacredness in Second Life. As in other media, opportunities arise to transgress normally respected notions of sacredness. A recent example of this is Telstra's (the Australian national telecommunications company) use of a model of Uluru (a profoundly sacred rock, protected by its Indigenous custodians) on their Second Life 'island' without permission from the traditional owners [4]. Strict rules governing photographing, filming and viewing of rock paintings associated with Uluru have been in place since 1987, when control of the rock was handed back to the traditional owners. Although in Telstra's simulation of the rock, barriers were provided to prevent avatars walking over sacred sites, visitors can view other sacred sites around the rock normally controlled. Moreover, that the ire of the administrators of Uluru (on behalf of the traditional Anangu people) was raised by this act suggests that notions of sacredness do extend to simulational spaces, and that transgression of appropriate respect for how they are re-presented needs to be addressed in simulational spaces as it is in other media.

The Digital Songlines Simulational Space

The simulation of Indigenous Australian sacred spaces in 3D virtual environments is not only restricted to those insensitive to its affects. A group of researchers in Australia, working closely with rural and urban Indigenous Australians, have been developing the 3D game platform as a storytelling vehicle. The Digital Songlines (DSL) digital storytelling project, funded by the Australasian Cooperative Research Centre for Interaction Design (ACID), has been developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of Australian indigenous cultural heritage knowledge since 2004. The project explores the areas of effective and culturally sensitive, recording, content management and virtual reality delivery capabilities involving indigenous custodians, leaders and communities from around Australia. It investigates how players, in a serious gaming sense, can experience Indigenous cultural heritage in a high fidelity fashion with culturally appropriate interface tools. In the construction of the DSL simulated environments, many sacred spaces are re-presented. Where this differs with the Uluru transgression is that these sacred

spaces are actively identified by their custodians as important parts of a larger story needing to be passed on to current and future generations. Yet, in turn, this raises questions of how this can be reconciled with the ability to transgress these spaces within the simulated environments by the uninitiated, or simply naiveté to its significance? The central charter for the construction of these simulational spaces is for the dissemination of cultural heritage knowledge. But, what sacrifice is being made in the transition to a world view (Western notions of universally accessible space) which is predicated on observable experimentation within these simulated spaces – some of which are sacred?

Simulational Space as Archive

In order to address the issue of transgressions of sacredness by the uninitiated, the DSL project involves a different kind of conditional engagement or encounter with the material contained. The DSL project uses its simulational spaces as active knowledge archives. This is different to traditional archiving (documents, photographs, video, film, audio, and so on). An archive is something that preserves and stores and provides access to things that are past. It's primary function is for the heritage and benefit of the people who come after. What the use of a 3DCG engine by the DSL team to create a simulational space provides is a digital platform that is dedicated to exploration and experimentation. This allows for active participation in the creation of contemporary stories contextually situated in their place of origin and access to historically sensitive stories often involving reconstructions of sacred sites. However, this sets up a tension between the possibility for futurist experimentation and traditional archiving, meaning the re-presentation of the knowledge recorded can often be too intrusive. The ability to control access and reproduction available to the traditional archive is foregone in favour of experimentation with the 'spaces' of the archive because the custodians of this knowledge consider it is too important not to be included. Of course much material can never be accessed, but many of the sacred sites included are simply considered too important to the authenticity of the stories to be told to be left out.

Added to this notion of the importance of the inclusion of sacred knowledge and spaces is the notion that archives often become a substitution for the thing they are trying to record or represent. The DSL project presents a different version of the same problem. The 'space' becomes the archive. DSE is a database which is activated by the spatialising engine that it uses. It becomes the simulational space for encountering those things it contains in terms of a different temporal orientation. The simulational spaces become a substitute in the archival

sense for the real, and they also inform the real in terms of the possibility for experimenting with what is possible with those spaces that it simulates. It means interactors can do things that they could not necessarily do in the real. In time, these actions also become a substitute for the real: if most peoples' interaction with the spaces are in the virtual, what happens when they visit the physical and expect to have the same access rights as those in the virtual, and so on?

More than this, the past, present, and future are conflated in these worlds. The archive becomes the reality. Everything that is simulated, in any kind of archive, is a representation of that time. In this sense, anthropological work is always an interpretation. Hence, it becomes archival, 'the fact' of that period. Yet, each subsequent generation interprets this same archive in terms of their own contemporary understandings. Charles Mountford [11] is an anthropologist from the mid twentieth century who recorded Aboriginality in his time. He talks about his encounters with Aboriginal people and builds characters around them. Particular individual Aboriginal people are photographed in his books, for which there were few protocols for how this should be done at the time. Geoffrey Bardon [1] is another non-indigenous person working in close relationship to Aboriginal groups, recording their art and craft in the 1970s. He did establish some protocols, but these were more about what he was hoping to achieve than a consensual set of guides open to negotiation with the people he was trying to protect. The sheer number of books Bardon [1] produced, of beautifully illustrated works, represents an archive in itself. Some of the works recorded are the most important Aboriginal artworks in Australia because of Bardon's [1] meticulous recordings and the iconography captured in them. Many of these icons are not seen in today's paintings because they are considered too sacred (the early paintings Bardon [1] recorded were produced in an atmosphere of naivety about who would have access to them). Mountford and Bardon's recordings are only two examples of the many anthropological works that demonstrate the evolving need to establish protocols for dealing with notions of sacredness and in what forms it can or cannot be re-presented.

As an archiving project, DSL is faced with the same challenge of respecting the material it records. Where DSL differs from previous archival projects is both its emphasis on contemporary culture contextualised within its historical background and that each project is instigated by a member of the culture it purports to re-present. DSL has established a set of protocols that are open to negotiation with the Indigenous peoples engaged [see 6]. Yet,

many compromises are confronted in its attempt to marry contemporary Aboriginal culture with traditional. The need to overcome these is paramount as the elders claim they are very worried that once they are gone their culture will go with them if it is not recorded. The younger generation they are trying to reach are more interested in playing computer games and engaging in mainstream culture to learn about their own heritage. Hence, in using the computer game as a platform, the elders are hoping to reach that generation using the same voice.

But, Indigenous Australian culture is very complex. It is not so easily reduced to the determinist confines of the 3DCG. Yet the very notion of simulation is to simplify the complex; to model phenomena in a manner that makes it more easily understood [2]. As such, by its very nature, simulation is selective from the beginning, because there is only so much that it can support. In a similar manner, only so much can be retrieved from a regular search of archives, in terms of documentation, and the documents themselves are very selective. In the least, because they are interpretations of events and already large deductions of what could potentially be recorded or shown. The most expensive flight simulator in the world cannot perfectly model every facet of flight, but they can do it to a level of functional affectivity which is good enough for pilot training. Hence, the DSL project can only ever be a compromise. Whether it achieves its goals of preserving the important aspects of the cultural heritage it seeks to capture is open to interpretation. What makes the DSL project unique is its idiosyncratic use of the 3DCG format and game-play. Combined, these express the needs of its creators rather than the 3DCG per se. This alone assists in presenting the DSLs game engine as an authentic and meaningful platform for communicating Indigenous storytelling, and is recognised as such by the various Indigenous communities engaged in its production, despite the ongoing conundrum of the inclusion of sacred sites and what this means to notions of sacredness in an open simulational space that invites experimentation.

Idiosyncratic Simulational Space

Development of the DSL game engine is not alone in its use of idiosyncratic game formatting. The recent emergence of idiosyncratic games outlined by Stiegler [14] represent a counter challenge to the spread of simulational culture in general. They actively question what can be done with goals other than the mainstream commercial application, instrument

training, or entertainment. The DSL project is an example of idiosyncratic use of a game engine to archive and reinvigorate cultural knowledge and practices.

DSL's use of the 3DCG engine as an archive is different from gaming in general because it engages the user in certain functions that are not related to game play but more like search functions. Yet the fact that it uses simulation of space, and that the whole game engine genre is built around this, also shows how space simulation is such a dominant model in our society [9, 12]. The navigation of space as traversed in the attainment of certain goals is, historically, a military position. In a military context, space becomes a trajectory, a series of trajectories to be overcome or navigated.

Hence, the challenge for DSL is to not trivialise certain parts of the culture that seem appealing and can be mapped onto contemporary non-Aboriginal culture simply because game engines are particularly good at specific types of game-play pursuits. The challenge for the DSL game engine is how to create authentic spaces and the game or role play in it. Should there be quests, and what can be learnt from those quests?, is of primary importance in terms of an educational outcome.

It is its localized (spatiotemporal) subjective interpretation, innovation, and adaptation or 'idiosyncraticity' that announces its peculiarly Australian Indigenous format and differentiates it from the more mainstream, historically militaristic games. The legacy this represents comes from a merging of the need of the Indigenous peoples involved and what the game platform can provide. Yet, in terms of the standard game behaviours that it implicitly involves or encourages or assumes still come from the history of computer culture in general: militarily techno-scientific developments around the 1940s onwards.

The DSL project avoids much of the militaristic legacy of the 3DCG because the fundaments of the DSL database is highly contextualised landscapes rather than quests alone. These landscapes are described in affectionate terms by their Indigenous custodians as an entity: 'country'. Everything is built on this notion of 'country' as an entity. 'Country' manifests the ancestral beings in terms of the dreaming and they are uttered into existence through the telling of stories embedded in their simulated 'country'. The naming of the landscape features in 'country' brings them into existence and maintains their existence, but it also allows for change over time. It is not a linear excursion, it is disjunct in that one can

wander around and find things which are both contextualised but approachable in many different ways.

For example, in the DSL's Vincent Serico World , one can stumble across one of his paintings relating to that part of 'country' one finds themselves in. The interactor can then right click and a screen pops up with his painting taking up most of the available interface (see figure 1). Sweeping the mouse cursor over the painting, the interactor notices hotspots. Clicking on one of these launches another popup with Vincent talking about that part of his painting and the stories behind it. There are also a series of small TV icons along the bottom of the frame that provide a linear sequence of voiceovers to follow. In a sense, the non-linear option most closely follows the nature of Indigenous storytelling; a story does not start at the beginning and end at the end, it can be entered at any point, and it can be changed and so on. In this manner, Serico's simulated world reflects some of those qualities. The TV icons are the Western abstracted symbolism announcing the audiovisual pop-ups (which rely on one knowing what the symbol for a TV looks like), whereas the hotspots (although reliant on an abstract change in the type of cursor and pre-knowledge on what this change means) are more closely related to parts of the painting and the haptic method of storytelling with paintings most familiar to Indigenous storytelling customs [see Figure 1].

The addition of hotspots as an aside surprise found in Vincent Serico's World is also an emergent strategy of mainstream game construction for maintaining interest in a game. In a contemporary mainstream first person shooter game these aside interactivities are used so the player can discover secrets which are usually superfluous to game play, if the main objective of the level is to kill all the monsters and go to the next level. While this may be the main goal, the additional asides make the game space more interesting. However, the main trajectory design of the space is still about moving through it and eliminating the targets to get to the next level. In the DSL simulated world, on the other hand, in the absence of this main role-play trajectory, it is, instead, discovery of the asides that becomes the main goal. It is this tension between moving in and out of the mainstream trajectory to an activity function inside the space, that has moved it from being peripheral to central, that captures the interactors' imagination.

Figure 1. *Vincent Serico painting embedded in 3D game interface and 'country', near Carnarvon Gorge, South-West Queensland, Australia. (Troopers, Vincent Serico 2003, acrylic on canvas 60x103cm).*

Permission to Visit Sacred Sites in a 3DCG

Vincent's World contains sacred spaces (rock art, monolithic rock totem formations, waterholes and so on). Ordinarily, visitors are discouraged from touching, seeing, or interacting with their physical corollary. For example, one should not touch or deface the rock art or approach it without paying particular attention to seasons and so on. Similarly, one should not clamber to the top of a monolithic rock just because a view is available from there. And, one should not swim in a waterhole without the appropriate permission from the local tribal elders. All of these are possible in the Vincent Serico World. Hence, the simulational space is both referent to the real, a re-presentation of the real, and subject to the same notions of sacredness, but at the same time, immune to these strictures because there is an implied and explicit permission from the outset. In the DSL game levels, interactors are accepted as honorary members of the local clan who's 'country' is being visited. This is bestowed upon each game level by the clan elders of the re-presented country.

Nevertheless, where simulation in serious gaming and training is normally approached with a hypothetical future orientation – what can we do with this simulation? – and often little thought is given to what relationship the simulation has to the real, with the DSL game engine, it is both prospective and also archival. Hence, despite the clan elders' permission to explore their country, there still exists a tension between the simulational temporal engagements about what can be done with it and the sorts of historical preservation, hopes, and ambitions are expected of it in an archival manner by the elders who instigate it.

Thus, it remains both a challenge and an absolutely important thing to be doing. The use of a 3DCG engine provides the platform to support the essential character of Indigenous cultural practice – the emphasis on 'country' as all-sustaining, spiritually and physically. Yet, the restrictions of the 3DCG engine, when compared to the rich physical-world narratives possible, are symptomatic of the reductivist approach exemplified in the modelling paradigm and manifest by gaming culture in general. The rise of the visual over haptic that identifies Western culture [8] stems from the same renaissance concept of placing oneself outside the space and experimenting objectively on it. This reduction of the whole to things in isolation is anathema to Indigenous cultural practices hence presents yet another dilemma.

On the other hand, what the DSL project heralds is also a departure from this monism. The unfolding narratives embedded in their 'country' of origin sees the landscape as not a backdrop but as an active, central, participant in the storytelling. In this sense, the DSL project challenges the gaming norm through its idiosyncraticity. Its subscription to the current global paradigm, what Derrida [5] calls "globalatinisation", both supports and makes it possible to be counter to this visual monism [8]. Hence, the DSL project is not a departure from the gaming genre norm but rather a paradigm shift within the existing system. As such, it also offers a new way forward for idiosyncratic gaming. Here is a simulational space that reserves sacredness by providing access rights from the outset. One enters with an understanding that there are certain behaviours to be observed when engaging with the sacred spaces contained. In turn, a new respect and understanding about another culture's notions of sacredness are honoured.

According to those involved in the project the younger generation are losing their heritage to this global paradigm. They see the way to make them engage in their own culture again is within rather than outside this paradigm. By including sacred space in their reconstructed

'country' they are better able to engage the respect sought from the younger generation targeted. The global paradigm, that both provides the mechanism for their engagement and the impetus to challenge it, is not reinforced by the technology, rather it is co-constituted by mainstream media technology in general (in McLuhan's [10] sense). This is because media is increasingly the primary means by which the world is encountered. Hence, to the extent that the West's media technology dominates perception experience today, it is also important for any kind of project, not only projects dealing with Indigenous issues, but all kinds of artistic and other culturally important projects, to engage the mainstream technology to have their messages heard. The DSL project has done this by idiosyncratically altering the accepted norms, to temporalise their message in ways that highlight and counter what makes them different to the mainstream and promotes a basic characterisation of the Indigenous culture – the embedding of storytelling in its country of origin – and make this appealing to Indigenous and non-indigenous potential interactors alike.

Conclusion

This paper arose from a discussion between two of the authors following a public lecture demonstrating the DSL project and Vincent Serico's World (one of the many commissioned 3DCGs). In particular, the notion of sacredness in a simulational space was broached because of comments from the lecture about the apparent inappropriateness of climbing atop a large rock in Vincent Serico's World. This led to mention of the recent case regarding Telstra's insensitive use of Uluru as an icon to promote itself in Second Life. What differentiates the two examples was that Telstra did not have the appropriate permissions to use the sacred Uluru, whereas the DSL project has explicit permission to include sacred spaces in its 3D reconstructions of specific 'country'. Nevertheless, both rely on the exactitudinal nature of a mathematically constructed simulational space. However, such spaces fall outside the normally controllable strictures of what could be considered sacred. This announced our first dilemma: the mathematical reproduction of three-dimensional space being founded on universalising notions that do not value one type of space over another, hence there is supposedly no place for notions of sacredness in this model. Moreover, their open, holistic, and definable nature, encouraging experimentation, is anathema to notions of sacredness. This led to the second dilemma: not all cultures subscribe to the notion of a universal spatial construct. Indeed, Indigenous Australian culture, the culture at the centre of the DSL project, conflates subject and object such that

representation becomes re-presentation, and thus the representation of sacred spaces in a 3DCG demands the same protection as its physical-world corollary. In turn, this led to our two further dilemmas, the tension between futurist experimentation inherent in the simulational spaces of the DSL project, and its aspirations as a spatial archive of sorts, and the need to use this technology to attain the 'voice' necessary to communicate an important message to a generation already familiar with gaming culture.

The last of these dilemmas unpacks into a conundrum: the DSL project is specifically tailored to use the features of the game engine to support the disjunct, non-linear, performative, character of Indigenous storytelling, yet it is also in direct competition with the global universalising paradigm that underpins the very same 3DCG technology that threatens to erode their culture. Despite and because of this, the Indigenous elders, along with the DSL project leaders, have made a paradigmatic shift within the system rather than reject it outright. This is manifest by the idiosyncratic approach to the construction of the DSL simulational spaces which at once talk to the generation targeted and communicate in a sensitive manner the sacredness of the messages contained. From this, a new genre of 'game as archive' has emerged – one which supports spatial narratives but makes no assumptions about the dismantling of its own sacredness due to the technology employed. We of the gaming fraternity could learn much from this approach about new ways to communicate the sacredness of some non-Indigenous sites!

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The Ethics of Indigenous Storytelling
Using the Torque Game Engine to Support Australian Aboriginal Cultural Heritage

Theodor G Wyeld - The University of Adelaide, ACID

Joti Carroll - ACID

Brendan Ledwich - ACID

Brett Leavy - Cyberdreaming, ACID

Craig Gibbons - ACID

James Hills - SGI, ACID

Abstract

Digital Songlines (DSL) is an Australasian CRC for Interaction Design (ACID) project that is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge. This paper outlines the goals achieved over the last three years in the ethics of developing the Digital Songlines game engine (DSE) toolkit that is used for Australian Indigenous storytelling. The project explores the sharing of indigenous Australian Aboriginal storytelling in a sensitive manner using a game engine.

The use of game engine in the field of Cultural Heritage is expanding. They are an important tool for the recording and re-presentation of historically, culturally, and sociologically significant places, infrastructure, and artefacts, as well as the stories that are associated with them in a highly situated context. The DSL implementation of a game engine to share storytelling provides an educational interface. Where the DSL implementation of a game engine in a CH application differs from others is in the nature of the game environment itself. It is modelled on the 'country' (the 'place' of their heritage which is so important to the clients' collective identity) and authentic fauna and flora that provides a highly contextualised setting for the stories to be told. This paper provides an overview of the ethics behind and the development of the DSL game engine.

Author Keywords: *Cultural Heritage, Storytelling, Torque Game Engine, Indigenous Heritage.*

Introduction

Digital Songlines (DSL) is an Australasian CRC for Interaction Design (ACID) project that is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge. This paper outlines the goals achieved over the last three years in the ethics of developing the Digital Songlines game engine (DSE) toolkit that is used for Australian Indigenous storytelling. The project explores the areas of effective recording, content management, and virtual reality delivery capabilities of culturally sensitive stories involving indigenous Australian Aboriginal custodians, leaders and communities. It provides a toolkit where players, in a serious gaming sense, can experience Indigenous virtual heritage in a high fidelity fashion with culturally appropriate interface tools.

Cultural Heritage (CH) is concerned with the preservation of historically, culturally, and sociologically significant places, infrastructure, or artefacts for current and future generations[1]. Most recently the use of virtual technologies to reconstruct, and thus explore in a non-intrusive manner, sites of CH significance have become an important tool in their preservation and investigation in highly situated contexts. More particularly, 3D real-time interactivity with these 'virtual' sites offers a new educational program for sharing the knowledge and information gathered about these sites. Many applications for real-time interactivity include the use of a game engine. A number of research institutions have explored the efficacies of using game engines to provide convincing reconstructions of places of cultural significance (MiraLab, VRLAb, LandLab, HitLab, MIT MediaLab, the Ikeuchi Crest Project, the JSA Bayon Project, MVS lab (The Virtual Room), iCinema, and ACID, among others).

Most of the reconstructions that inform the CH of these projects is the modelling of past civilisations [1]. They also tend to address built environments rather than the landscapes that envelope these buildings. Most built environments follow an orthogonal format. Game engines and their associated modelling packages are particularly well suited to simulating orthogonal built environments [2]. Where the DSL developed game engine differs significantly from these more typical CH implementations of the game engine is in its re-presentation of non-orthogonal environments. The DSL game engine supports embedding of Indigenous Australian storytelling (an important and central component of indigenous

[1] The two key bodies with the primary charter for the preservation of world heritage sites are UNESCO (United Nations Educational, Scientific and Cultural Organization) and ICOMOS (International Council on Monuments and Sites).

Australian CH) in its natural landscapes. As such, the focus is on authentic organic landscapes, fauna and flora rather than built environments per se.

This paper includes a brief background on the DSL project and Indigenous virtual heritage, overview of the DSE toolkit, implementation experiences, the cultural heritage philosophy of the DSE development process, implementation of the toolkit and, and the ethical considerations of such a design in the form of protocols for engagement consultation with Indigenous Australian clients.

Introduction to Digital Songlines

The Australasian CRC for Interaction Design (ACID) is a collaborative research organisation formed with a number of Universities and industry partners. Within the Virtual Heritage program the Digital Songlines project is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge across Australian communities, cultural institutions and commercial businesses.

The Australian Aboriginal and their culture are known to be some of the oldest in the world. Aboriginal occupation in Australia has been dated at over sixty thousand years, with recent advances and scientific discoveries continuing to change this time frame [3, 4, 5, 6, 7, 8]. As such, the DSL project objectives are to protect, preserve and promote Australian Indigenous culture (an ancient and alive culture), its practices, myths and legends, expanding and re-vitalizing a culture through the visualization of its most prized asset – the land. The project has developed a virtual landscape of oral histories and mythological stories based upon the eternal sense of land and spirituality understood by the Aboriginal people. Research to-date has been focused on investigating how the design of virtual environments can capture the spirituality, significance, cultural importance and heritage values of Indigenous people and impart these in an empathic way so that indigenous and non-indigenous people alike throughout the world can understand the significance and cultural heritage of these areas.

Background: Indigenous Cultural Heritage

Traditional Aboriginal culture was passed on to others through oral traditions, art, dance and rituals. Aboriginal Legends have served an important purpose in the teaching and learning for Aboriginal people, adding to their understanding, connection and interpretation of the world in which they live. Stories are a means by which knowledge and understanding is

passed from generation to generation. As they live with such a close connection to the country and seasons, know it so intimately, the stories, songs and culture are inextricably linked to the land. Aboriginal culture is still alive today with older people from the country still able to tell their stories [9].

In the Digital Songlines project we aim to communicate the culture, history, rituals and stories and their association with the country through 3D virtual environments, by re-presenting these in the context of the originating country. The importance of this work is in the way it demonstrates an appreciation of the natural environment and the Aboriginal affinity to this land. The game-based virtual environments seek to explore the spiritual, mythic, magic and superstitions of the landscape as a traditional hunting ground and hallowed place of worship. To-date, the Digital Songlines project has been used to illustrate a number of significant Aboriginal spaces within Australia [10][2].

The Digital Songlines Toolkit

A core component of the Digital Songlines project is the ongoing development of a digital toolkit. The aim of the toolkit is to allow communities of Australian Indigenous peoples to create their own virtual cultural landscapes through story telling in a 3D gaming environment. As well as being available for indigenous heritage storytelling, this toolkit can also be used to communicate issues of sustainability, land use, water use, explain development issues and contested narrative issues for a number of different uses. The toolkit can be used to facilitate asset management over a large geographical area. While the primary use of the tool has been in the area of cultural history, a wide range of potential installations have been identified including: museums, science centres, cultural centres, interpretive centres, community consultation, local councils, forestry, water resources, development organisations, schools, mining, safety training, media and data fusion capabilities.

The DSL software developed to-date is based on the display and manipulation of arrays of 3D objects recreating landscapes populated by indigenous flora and fauna. These assets have been imported into the game style application based on the Torque Game Engine (TGE) [see 11]. The active features include sound [33, 34], animations, artificial intelligence [14, 15], weather and daylight simulation. An established mechanism to import digital terrain

[2] See also [32] for a more detailed discussion on an example of Aboriginal rock art modelling.

models has been modified for importing satellite based geo-spatial data, or data that is prepared for use in GIS software, for accurately mapping the cultural heritage landscape.

Many issues arise from the creation of virtual spaces representing vast rural lands and its reliance on the computational capacity of real-time hardware and visualization technologies. Some are difficult to resolve in a suitable way to communicate the presence required within the virtual space. For example, how to convey immersive narratologies such as, while in place, indigenous knowing pauses at each rock, knows the cycles of the winds, can track underground water, find food and medicine, and uses of the land to speak its stories and keep its history? The kind of knowledge represented and the 'field' in which it is held by local indigenous peoples is often deep, subtle and most intimate [12].

Although some of these issues remain unresolved, most have been addressed by a 'tiered' model of development. 'Layers' of content are created, accessed, and linked back to the virtual model of the physical place. With such a model, we are able to conceive of the (virtual) land as an interface through which the more traditional dynamics of software creation can be accessed. Moreover, this layered model allows the creator to participate in indigenous knowing and being-with, at the most basic level, as the tool is used.
The content can be layered to support virtual heritage applications and narratives (such as land ownership issues, spiritual knowledge, historical and oral stories) and as a community content development and archiving tool (re-populate the virtual spaces with indigenous content). These can be used in entertainment, display, community consultation and education, such as museums, cultural centre displays, as an indigenous language walk, 'bush tucker' walk, or oral history lesson. These are all developed with the notion of land-as-interface where the (virtual) land is layered with information and practices that arise from that very landscape.

Philosophy of the DSE Development Process

Most of the clients for the development of a DSE-supported virtual heritage simulation are groups of Indigenous Australian people who have a strong desire to maintain and share local cultural knowledge. However, as they are often located far from major urban centres funding is a primary issue. The low-budget nature of these projects is disproportional with their importance to the groups involved and Australian cultural heritage in general. Hence, this aspect of each project has to be taken into account when planning what can be

achieved within time and budget constraints. However, budget aside, the most significant issue expressed by all groups is the need for a strict region-based authenticity. This relates to landscape re-presentation, totems (local cultural and spiritual signifiers), and storytelling alike. Finally, the toolkit developed for the client must also be easy to use for the management of the stories contained and for new stories to be added over time.
The features of the landscape and the fauna and flora contained must be faithfully reproduced in such a manner that the stories to be told in this medium are closely linked visually and experientially with their 'country' of origin (the local landscape environment which may extend beyond view – literally and metaphorically) and on budget. Hence, working with individuals within the community and in the development or construction phase, ethical, moral, social, and budgetary issues are raised daily. These are discussed as a group and a cyclical process of consultation with the various communities engaged is sought at each juncture.

The underpinning philosophy of the DSL game engine and content development work is to provide an accurate, affordable solution to a community that is directed and owned by that community and meets their needs. Much of the material gathered is of a sensitive nature[3]. The main concerns are aural, visual, and narratological authenticity. Working in real environments – established and traditional community lands – these environments have to be accurately re-presented. Each project has specific requirements. Thus, new assets are created for each project. Assets from one project are not easily transferable to another. For example, we cannot use didgeridoo music where it does not belong in that country. Along with other assets within the country, 'country' itself can be thought of as an artefact. It is the largest artefact in Aboriginal culture. The accurate portrayed of this country is thus of paramount importance. As ostensibly an educational product, if we create inaccurate environments then 'inter-actors' (not just users) with the product may be misled about a particular story, or scene within a story. This has implications not just for knowledge acquisition and cultural maintenance for posterity but, in Australian Aboriginal culture, the

[3] There are a number of sensitivities involved in the garnering of support, gathering and application information. In the first instance, the communities involved need to be actively seeking technological applications for the implementation and re-distribution of their local knowledge on a game-based platform. The groups and their members need to have the appropriate authority from their clan elders to talk with the DSL team about cultural heritage issues. There are some sacred and spiritual knowledge that cannot be shared without those with access having gone through a lengthy initiation process. But the initiation process itself is too sensitive to discuss hence will never be a part of any DSL project. The only information available in this area is of a very generalised anthropological nature form past studies. There is little or no contemporary access to this knowledge.

inaccurate telling of stories may affect the environments they refer to with deleterious spiritual consequences.

There are vital differences in Western and Aboriginal knowledge traditions and practices. Western traditions emphasise the differences between subject and object, between what exists and how we represent it in a variety of symbolic systems. By contrast Aboriginal knowledge traditions emphasise the unity of subject and object – of what exists and how we represent it. In Aboriginal knowledge traditions, language, ceremony, singing, dancing and other representational forms can influence events and cause things to happen. Objects and phenomena can be "sung" into and out of existence. These processes of the amalgamation of representation and reality have been going on since the Dreamtime (in Australian Aboriginal terms, the time of creation of all things) and continue to this day (see [13] for a more detailed discussion on this topic).

Figure 1: *Screen image of animated fish with representative contemporary Indigenous art work.*

With 'country as artefact', unlike most gaming environments, the landscapes depicted in the DSE environment are not just a backdrop. It is very much an enveloping influence on the overall immersive experience [16]. It is both a receptacle and it actively participates in the telling of the story. Hence, every component developed must bear the burden of the responsibility to re-present country accurately. There are few insignificant details that can be excluded – everything matters. To ensure this accuracy, an extensive consultation process is conducted with the original custodians of the story – to ensure the assets have been used in the correct manner. This includes not just the landscapes but the knowledge that is embedding in those landscapes. Each individual plant and animal must be of the correct type or subspecies, and the narratological information associated with them has to be accurate and authentic. For example, a totem animal or Yurdi (an animal of special significance) may have a recurring theme in a story told by a particular community.

Therefore, it must be included. Different animals have differing significance in different country. Another challenge is when the landscape, or the fauna or flora it contains, needs to be abstracted in some manner. For example, when contemporary artwork is used as a texture map for a Yurdi, it must be of the appropriate type and created by an artist from that region using the correct iconography for that animal in its landscape context and the context of the story itself. For example, the artwork and the fish in Figure 1 are incongruous, and should be replaced by more accurate artwork from a local Indigenous artist associated with fish of that type in their region. These are complex operations that require diligence and be allowed for in the production budget.

The Project Cycle

Each project follows an iterative cycle. Initial planning is done in consultation with the community onsite. Planning which occurs offsite is returned for comment. Consultation continues throughout the project's development. A project cannot be finalised until this authentication process is completed. The typical process includes:

1. *visiting a remote community;*
2. *members of that community are shown the main features of the DSE toolkit environment; and,*
3. *their needs are discussed.*

This may take several days. In the mean time, other members of the team may collect photographs, video, sounds, and samples of local materials, such as bird noises, grasses, and notes on and photographs of local landscape features with the permission of the community custodians. These are then used in conjunction with satellite and aerial photography of the region to build the toolkit. From this, a 3D 'snapshot' of their country is created. In prototype form, it is returned for comment. From this, more information is provided by the clients about what they would like to see in their simulated country, the stories, what animals are needed and so on. A collection of agreed fauna and flora is modelled and animated. From here a core version of the stories in the virtual environment can be generated. This is again returned for further consultation, and so on, until consensus is reached on levels of authentication. Once the authentication process is completed the developed toolkit is handed over to the custodians of the client community for their express use and distribution.

Implementation of the Toolkit

With the specific DSE implementation of the TGE in the context of country-embedded Australian indigenous storytelling, the DSE toolkit assists the rapid authentic and inexpensive creation of 3D scenes in a cultural heritage template. Moreover, the DSE toolkit assists and fosters the maintenance and sharing of indigenous Australian storytelling through its accessible, flexible, and intuitive interface (see http://songlines.interactiondesign.com.au/). This has been achieved by the conscious application of the core DSE development philosophy, outlined earlier: consultation, authentication, budget wise, and ease of use.

The DSE toolkit is based on the notion of a strict landscape metaphor with editors that allows one to alter that environment using a game editor – add objects and place them, and alter their behaviours from a large gallery of components. With a licensed toolkit, one is presented with a complete simulated environment with all their needs. The various community groups are able to find their region and associated forests, and the sorts of trees and animals with behaviours already attached and characters and camps they need. They can then add dialogue to those characters, and rich media components, such as pop-up media: videos, images, and voice over. All of this is served by a central portal that supports the development and traditional communities alike.

The implementation in DSL of a networked structure of community-based content creation is a powerful paradigm model for research in interaction design, ambient, or serious gaming. The sociologist Manuel Castells [17] describes such networks as consisting of knowledge-based information technologies which enhance and accelerate the production of knowledge and information, in a self-expanding, virtuous circle. The network represents the divergence of production, access to, and display of nodes of knowledge. While traditional models of production in the field of display-based technologies tend to concentrate on either the product (the game), or the hardware (display), DSL sees workflows and methodologies that incorporate and evolve the two in a constant communication for the life of the product. For DSL, this communication begins with the recognition that the landscape is the ideal and essential metaphor for addressing indigenous cultural heritage issues, and provides a rich base for branching development and production.

The networked toolkit, as represented by DSL, becomes an empowering model of research and production – at once a site for capturing, archiving, developing culturally-appropriate virtual environments, and a site for sharing, collaboration and community content development. In the networked environment, knowledge becomes more powerful as it is shared and deployed [18-23]. DSL has grown through this network model. The umbrella of digital content and database development has provided a rich sandbox of opportunities for researchers, communities, educators, archivists, government and non-government organizations alike.

How we see, store, integrate and serve knowledge across the network is vital. Rather than merely seeking to refine and consolidate existing forms of knowledge – film, 3D animation, or game technologies – DSL has sought to provide methods of access and creation across combined knowledge bases, as it concentrates not only on the tool, but shapes itself to support and enable the voices which are carried upon and create the tool.

Evaluation

The Digital Songlines project has been a joint collaboration with the research and development team and numerous Aboriginal communities, groups, schools and museums. These groups have grasped the opportunity to gather information relating to their particular area of 'country' using a range of digital media. Our joint collaboration has not only led to the skilling of many community members in digital media, but has provided a cultural focus for the sharing of knowledge practices between generations. Early, evaluation groups of Aboriginal adults and children have responded enthusiastically both to the Songlines concept and also to the visual interface and interactive activities that are possible within the Songlines environment.

Evaluation of the Songlines environment and user interactions has yielded rich data about the nature of representation of Aboriginal knowledge, the pedagogical implications for Aboriginal learners, and the participatory design process for the construction of accurate local landscapes and cultural activities. The key thematic areas addressed to-date include, language learning, traditional food sources or 'bush tucker', traditional crafts (see figure 2), and narratives associated with traditional landscape representation in painting

Figure 2: *Screen shots of the Digital Songlines project interface showing net-making, grain grinding, and spear-making.*

Feedback

All evaluation has occurred in networked collaborative settings with educators, developers and participants interacting both physically and virtually through the media. Participants varied in their make-up. Ages ranged from primary school children through secondary school, and adults. Each session took about 30mins – this is the time needed to learn how to navigate in the world.

With a range of ages of participants represented there were multiple expectations of the kinds of learning the Digital Songlines environment could support. Preliminary feedback indicates that young participants, already familiar with the gaming culture, came to the pedagogical exercises with prior expectations on how games work and were either

disappointed that the Digital Songlines environment was not like their own (commercial) games, or delighted that it was better. Where the younger participants expected typical game-like activities and tasks, including quests, the older participants looked for tribal stories, traditions and languages to be 'brought to life' so they could pass them on to the next generation. Older participants and educators saw the most important feature of the tool was how it allowed for exploration of the media so that they could construct their own materials for addition to the environment. They saw this process as evocative of 'real' learning through experience and recreation of a 'living history'. The game became a kind of 'new literacy'. Some of the more negative experiences included: younger children (not yet acculturated to game-playing) became quickly disoriented, and right clicking for information was not intuitive. Some of the more salient discoveries are listed here:

Aboriginal children who participated in this exercise showed great pride when they saw their efforts represented through the program. They were surprised at the rich graphics and interaction. Some commented that it was representation of the past – like as time machine. Others said it reflected the contemporary environment. Thus, as a tool for empowering self-determination and overcoming negative stereotyping by mainstream media, it was instrumental in dismantling preconceived ideas of self-worth and image – the normally held view that somehow indigenous peoples 'cannot do this kind of non-indigenous hi-tech work.'

Most of the younger participants, seven years of age and older, were used to games software which included some sort of quest. Therefore, they were focused on killing animals in the scene rather than investigating other features, such as visiting one of the campsites. They needed a purpose to go to the campsite. Their prior games acculturation meant they thought of interaction with games software as a demonstration of skills and the completion of tasks. To make them walk to the campsite, it was necessary for the teachers present to give them clear guidelines, a mission, or quest.

In terms of language acquisition, we found that to learn some of the words, children needed to repeat the words as they listened to them, or have collective sessions with their teachers after interacting with the Digital Songlines environment to have particular points not clear in the game environment explained.

A small difference in age groups made a big difference in how they interacted. Younger children took quite a while to engage and understand the exploration method and simple teacher-directed quests. These preschool children were still acquiring motor skills and needed various levels of mouse mastery to navigate. However, this was achieved within the timeframe of the session. Older children requested more of a challenge or quest-based interaction.

There was a high level of interaction between the players. They talked to each other about what they saw and what they were doing. This indicates a strong association, connection and engagement with the software and environment depicted.

Conclusion

This paper outlines the development of protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge developed by the DSL team over the past three years. The DSE toolkit used for Australian Indigenous storytelling developed over this period goes some way towards helping to preserve the historically, culturally, and sociologically significant places, infrastructure, and artefacts of many remote Australian Indigenous communities for current and future generations in highly situated contexts [32]. The use of a game engine has proven to be instrumental in engaging with young and old members of these communities alike. Its 3D real-time interactivity provides an educational platform for the sharing of local knowledge. The three-dimensionality of the game environment also provides an appropriate interface for contextualising Australian Aboriginal knowledge sharing in its re-presentation of their most important cultural artefact 'country', embedded with authentic fauna and flora. This work highlights the need to find new ways to communicate diverse cultural understandings. More particularly, how technology can assist in the empowering of cultural identity in an increasingly homogenous world mediated by Western cultural values advanced by the same technology.

Protocols

It is important to develop a set of protocols for dealing with the intellectual property and copyright issues regarding Aboriginal cultural knowledge. This is intended to ensure that respect and recognition of such knowledge occurs and that protection from abuse of such information is avoided. The following protocols were developed after original research and

review of existing protocol documentation (such as that contained in: [24-31]). They are addressed at each phase of the toolkit production:

1. *That the stories of Traditional Owners be recognised as a 'body of knowledge' that may be tens of thousands of years old.*
2. *That the stories are sourced from the Traditional Owner who represents the country of which that story might originate.*
3. *That the communities make their own decision on what stories they want to have represented in any Virtual Heritage project.*
4. *That an approval process be implemented and approved by communities.*
5. *That the story represents the community and clan, and is specifically placed geographically.*
6. *Ownership and copyright of the story is always held by the nominated traditional owner group or community council.*
7. *That the content of the Virtual Heritage application including artist styles is approved by the community at all key production stages.*
8. *That the story provided by the community is not modified unless approved and endorsed by the Traditional Owner representative of that community.*
9. *That the community be paid industry standard rates and receives royalties from revenue earned from any capitalization and commercialisation.*
10. *That Indigenous people design and participate in the creation of the Virtual Heritage application development at all stages of planning, design and production.*

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Digital Songlines
Digitalising the Cultural landscape of Aboriginal Australia

B. Leavy, T. Wyeld, J. Hills, C. Barker
Queensland University of Technology, Australia.
IEP, ITEE, University of Queensland, Australia.
Australian CRC for Interactive Design (ACID) Australia.
and
S. GARD
Queensland University of Technology, Australia.
Australian CRC for Interactive Design (ACID) Australia.

Abstract

These instructions are intended to guide contributors to the proceedings of the New Heritage conference when preparing papers. The abstract is in 10 pt Times with 11 pt leading. Digital Songlines is an Australasian CRC for Interaction Design (ACID) project that is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge. This research will illustrate significant Australian Indigenous spaces such as the Mt Moffatt area at Carnarvon Gorge in south-west Queensland and areas around the Pilbarra in Western Australia. The project explores the areas of effective recording, content management and virtual reality delivery capabilities that are culturally sensitive and involve the indigenous custodians, leaders and communities in those areas as well as how players in a serious gaming sense can experience Indigenous virtual heritage in a high fidelity fashion with culturally appropriate interface tools.

Introduction to Digital Songlines

The Australasian CRC for Interaction Design (ACID) is a collaborative research organisation formed with a number of Universities and industry partners. Within the Virtual Heritage program the Digital Songlines project is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge across Australian communities, cultural institutions and commercial businesses.

The Australian Aboriginal and their culture are known to be some of the oldest in the world. Aboriginal occupation in Australia has been dated at over sixty thousand years, with recent advances and scientific discoveries continuing to change this time frame. Before 1788, when English settlement commenced in Australia there were approximately 600 languages spoken throughout Australia, with an estimated Indigenous population of 750,000 people (Henderson 1997). Today Indigenous people make up 2% of the entire Australian population (about 410,000 people). Most of our knowledge of Aboriginal culture is derived from the diverse cultures recorded of relatively modern Aboriginals, particularly those who survived the impact of European colonisation. Hence, the culture of much earlier Australian inhabitants remains problematic (Bickford 1987; Byrne 2003; Cook 1986; Elkin 1953; Memmott 1991; Ridgeway 1984).

The project objectives are to protect, preserve and promote Australian Indigenous culture, its practices, myths and legends, expanding and re-vitalizing a culture through the visualization of its most prized asset – the land. The project has developed a virtual landscape of oral histories and mythological stories based upon the eternal sense of land and spirituality understood by the Aboriginal people, where feeling, knowing and touching the country, kin and spirit can be experienced.
Research to date has been focused on investigating how the design of virtual worlds can capture the spirituality, significance, cultural importance and heritage values of Indigenous people and impart these in an empathic way so that non-indigenous people throughout the world can understand the significance and cultural heritage of these areas.

This paper includes a brief background on Indigenous virtual heritage, how the virtual world was made, what Indigenous design aesthetics were sought, what journeys a player can have, and, the ethical considerations of such a design, and ultimately, what form commercial production will take.

Background: Indigenous Cultural Heritage

Traditional Aboriginal culture was passed onto others through oral traditions, art, dance and rituals. Aboriginal Legends have served an important purpose in the teaching and learning for Aboriginal people, adding to their understanding, connection and interpretation of the world in which they live.

The stories were the means by which knowledge and understanding were passed from generation to generation for over forty thousand years. These 'yarns' are vivid, dramatic and informative stories that served the purpose of educating the receiver about all the social, environmental and cultural facts that ensured the ongoing survival and prosperity of the clan.

Because they lived with such a close connection to the country and seasons, knew it so intimately, the stories, songs and culture are inextricably linked to the land. For example, Rose (1996) says:

> *There is no place without a history; there is no place that has not been imaginatively grasped through song, dance and design, no place where traditional owners cannot see the imprint of sacred creation' and 'People talk about country in the same way that they would talk about a person: they speak to country, sing to country, visit country, worry about country, feel sorry for country, and long for country. People say that country knows, hears, smells, takes notice, takes care, is sorry or happy... country is a living entity with a yesterday, today and tomorrow, with a consciousness, and a will toward life. Because of this richness, country is home, and peace; nourishment for body, mind, and spirit; heart's ease.*

Aboriginal culture is still alive today with older people from the country still able to tell their stories. However, many are passing on and the younger people are becoming lost in the struggle between white and traditional cultures. Some want to know and understand their cultural roots, others want to embrace Western values and deny their heritage. Yet others are simply lost in cultural ambiguity.
In the Digital Songlines project we aim to communicate the culture, history, rituals and stories and association with the country through 3D virtual worlds, by presenting these in the context of the originating country. The importance of this work is in the way it demonstrates an appreciation of the natural environment and the Aboriginal affinity to this land. The virtual world seeks to explore the spiritual, mythic, magic and superstitions of the landscape as a traditional hunting ground and hallowed place of worship.

Places of Cultural Significance

To-date, the Digital Songlines project has been used to illustrate significant Aboriginal spaces within Australia such as the Mt Moffatt and Carnarvon Gorge National Park areas in south-west Queensland The landscape and surrounding country in these

regions is largely undisturbed by modern activities. As such it is a pristine land of gum trees, eucalypts, ironbarks, mulga, caves, granite and sandstone rock formations and fertile, grassy plains. There are innumerable significant places that are marked by a vast array of distinct and special rock art paintings and other cultural artefacts. They contain major meeting places where many different clans descended each year for many months to trade, meet, discuss and follow many practices vital to the survival of the group and the maintenance of their cultural traditions.

The Digital Songlines Toolkit

A core component of the Digital Songlines project is the ongoing development of a digital toolkit. The aim of the toolkit is to be able to effectively communicate meaningful cultural information through a 3D landscape format so the information can be conveyed in context within country. As well as being used for indigenous heritage, this toolkit can also be used to communicate issues of sustainability, land use, water use, explain development issues and contested narrative issues for a number of different uses.

The toolkit facilitates asset management over a large geographical area. This is done preserving high quality local detail. To-date the toolkit features include:

1. *3D landscapes based on satellite imagery (with GPS level accuracy at the macro scale);*
2. *the ability to set weather, time of day, or progressive time etc;*
3. *user level tools to manipulate the landscape and add finer detail at a micro level;*
4. *the ability to create scenarios and stories and control these through scripts and control of camera position;*
5. *the ability to create journey paths through the landscape and control the speed and direction along a path;*
6. *the ability to add flora and fauna related to the area from a database or catalogue of objects;*
7. *the ability to add ambient audio (wind in trees, bird calls etc), voice over for significant locations (explaining the significance of a place to a viewer, explaining our presence to the spirits etc), and oral history (automated or selected avatars);*
8. *using the ability to link to data attributes for presentation of educational material. For example, select information about: flora with botanical data; medicinal; bush tucker; and artefact information, such as the making of implements for food gathering, or, use as weapons; and,*
9. *the ability to participate in massive multi-user serious gaming strategies.*

10. *While the primary use of the tool has been in the area of cultural history, a wide range of potential installations have been identified including: museums, science centres, cultural centres, interpretive centres, community consultation, local councils, forestry, water resources, development organisations, schools, mining, safety training, media and data fusion capabilities.*

Implementation Experiences

A highly resolved proof-of-concept prototype has been developed which includes arrays of 3D objects used to recreate a landscape populated by indigenous flora and fauna. These assets have been imported into the game style application based on the Torque Game Engine. The active features include sound, animations, weather and daylight simulation. An established mechanism to import digital terrain models existed and it was modified for importing satellite based geo-spatial data, or data that is prepared for use in GIS software, for accurately mapping the cultural heritage landscape (see figure 1).

Figure 1. *Screen images of the Digital Songlines interface.*

The terrain data in vector or raster based formats is layered with spatial attributes that identifies where the features are located in geographic space as relevant to Indigenous cultural heritage. The geo-spatial data includes various files that make up a cultural metafile set with vector data representing trade routes (Songlines), a table containing the artefacts belonging to significant places and their location, and data including the indigenous names for sites, watercourses, hunting grounds, 'scar trees' and other significant places. These are positioned correctly in the 3D world using GPS.
In addition, native vegetation specific to the area is included in the 3D world. Flora and fauna are surveyed and photographed on-site and modelled for inclusion in the environment.

A prototype of a significant area around the Carnarvon Gorge Mt Moffatt region (a 400 square kilometre zone) has been developed to demonstrate capabilities and determine the limitations of the software. Some areas of interest include sandstone cliff faces with numerous Aboriginal stencil art paintings that are well preserved (Flood 1997; Meehan 1995). Photogrammetry techniques were used to develop a realistic virtual model of the irregular cliff face (see figure 2).

Figure 2. *Mt Moffatt cave paintings "The Tombs". Archaeological excavations have shown that*
Aboriginal people inhabited these sandstone rock shelters for some 19,500 years.

The standard landscape creation tool in the software cannot create overhanging cliff faces so these are created as 3D models and inserted into the landscape. Other areas where the tool capabilities need to be enhanced is in the integration of avatars and animated sequences. These include animated sequences from an Aboriginal dreamtime story. Developing the art works for the animations and 3D objects with cultural significance required consultation with indigenous artists and representatives from the country to ensure they were portrayed correctly. For example, the art work on the fish in Figure 3 is not correct and should be replaced by more accurate art work from a local Indigenous artist.

Figure 3. *Screen image of animated fish with representative contemporary Indigenous art work.*

Many issues arise from the creation of virtual spaces of some 400 square kms and its reliance on the computational capacity of real-time hardware and visualization technologies. Some are difficult to resolve in a suitable way to communicate the presence required within the virtual space. For example, how to convey immersive narratologies such as, while in place, indigenous knowing pauses at each rock, knows the cycles of the winds, can track underground water, find food and medicine, and uses of the land to speak its stories and keep its history. The kind of knowledge represented and the 'field' in which it is held by local indigenous peoples is often deep, subtle and most intimate (Langloh-Parker 1953).

A 'tiered' model has been developed where 'layers' of content are created, accessed, and linked back to the virtual model of the physical place. With such a model, we are able to conceive of the (virtual) land as an interface through which the more traditional dynamics of software creation can be accessed. This layered model allows us to participate in indigenous knowing and being-with, at the most basic level, as the tool is used.

The content can be layered to support virtual heritage applications and narratives (such as land ownership issues, spiritual knowledge, historical and oral stories) and as a community content development and archiving tool (re-populate the virtual spaces with indigenous content). These can be used in entertainment, display, community consultation and education, such as museums, cultural centre displays, as an indigenous language walk, or bush tucker walk, or oral history lesson. These are all

developed with the notion of land-as-interface where the (virtual) land is layered with information and practices that arise from that very landscape.

The Digital Songlines toolkit can be conceptually defined in use as comprising of 3 separate and interconnected sources of knowledge presentation – Stories, Education and Maps. These categories loosely capture the scope of the project, including the different categories of users.

Implementation of the Toolkit

The implementation in Digital Songlines of networked structure of community-based content creation is a powerful paradigm model for research in interaction design, ambient, or serious gaming. The sociologist Manuel Castells (2000) describes such networks as consisting of knowledge-based information technologies which enhance and accelerate the production of knowledge and information, in a self-expanding, virtuous circle. The network represents the divergence of production, access, and display of nodes of knowledge. While traditional models of production in the field of display-based technologies tend to concentrate on either the product (the game), or the hardware (display), Digital Songlines sees workflows and methodologies that incorporate and evolve the two in a constant communication for the life of the product. For Digital Songlines, this communication begins with the recognition that the landscape is the ideal and essential metaphor for addressing indigenous cultural heritage issues, and provides a rich base for branching development and production.

The networked toolkit, as represented by Digital Songlines, becomes an empowering model of research and production – at once a site for capturing, archiving, developing culturally-appropriate virtual environments, and a site for sharing, collaboration and community content development. In the networked environment, knowledge becomes more powerful as it is shared and deployed (Gutierrez and Seron 2004; Ibanez and Ruiz-Rodarte 2003; Kim and Kesavadas 2001; Lutz and Weintke 1999; Marini and Rossi 1997; Sanders 2001). Digital Songlines has grown through this network model. The umbrella of digital content and database development has provided a rich sandbox of opportunities for researchers, communities, educators, archivists, government and non-government organizations alike.

How we see, store, integrate and serve knowledge across the network is vital. Rather than merely seeking to refine and consolidate existing forms of knowledge – film, 3D

animation, or game technologies – Digital Songlines has sought to provide methods of access and creation across combined knowledge bases, as it concentrates not only on the tool, but shapes itself to support and enable the voices which are carried upon and create the tool.

Protocols

It is important to develop a set of protocols for dealing with the intellectual property and copyright issues regarding Aboriginal cultural knowledge. This is intended to ensure that respect and recognition of such knowledge occurs and that protection from abuse of such information is avoided. The following protocols were developed after original research and review of existing protocol documentation (such as that contained in: ATSILS 1999; AIATSIS & ATSIC 2002; Bell 1997; Bostock 1997; Cooper et al 2000; DATSIP 1998; Mellor & Janke 2001; Museums Australia 1998; and, NAVA 1998):
That the stories of Traditional Owners be recognised as a 'body of knowledge' that may be tens of thousands of years old.

1. *That the stories are sourced from the Traditional Owner who represents the country of which that story might originate.*
2. *That the communities make their own decision on what stories they want to have represented in any Virtual Heritage project.*
3. *That an approval process be implemented and approved by communities.*
4. *That the story represents the community and clan, and is specifically placed geographically.*
5. *Ownership and copyright of the story is always held by the nominated traditional owner group or community council.*
6. *That the content of the Virtual Heritage application including artist styles is approved by the community at all key production stages.*
7. *That the story provided by the community is not modified unless approved and endorsed by the Traditional Owner representative of that community.*
8. *That the community be paid industry standard rates and receives royalties from revenue earned from any capitalization and commercialisation.*
9. *That Indigenous people design and participate in the creation of the Virtual Heritage application development at all stages of planning, design and production.*

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Improvements to the Standard Torque Game Engine for Australian Indigenous Storytelling: Developing the Digital Songlines Game Engine

Brett Leavy[3,2], Theodor G Wyeld[1,2], Joti Carroll[2], Craig Gibbons[2], Brendan Ledwich[2], and James Hills[4,2].

[1] Swinburne University of Technology, the [2]Australasian CRC for Interaction Design (ACID), [3]Cyberdreaming Queensland University of Technology, [4]Silicon Graphics (SGI)

Abstract

This paper reports on the development of the Torque Game Engine (TGE) as a digital storytelling platform for Indigenous Australian storytelling. It outlines the project cycle, improvements to the base TGE, and the key features of the Digital Songlines engine (DSE) version of the TGE. It concludes with an overview of recent implementations of the DSE. The Digital Songlines project is funded by the Australasian Cooperative Research Centre for Interaction Design (ACID). It has been developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of Australian indigenous cultural heritage knowledge. The project explores the areas of effective recording, content management and virtual reality delivery capabilities that are culturally sensitive and involve the indigenous custodians, leaders and communities from around Australia. It investigates how players, in a serious gaming sense, can experience Indigenous virtual heritage in a high fidelity fashion with culturally appropriate interface tools. This paper reports on the development of the specific technology which makes the game engine most suitable for the goals of this project.

Keywords: *3D games, Indigenous Storytelling, Cultural Heritage, Torque Game Engine*

Introduction

The Digital Songlines (DSL) game engine (DSE) is built on and extends the standard Torque Game Engine® (TGE). In this paper we outline the improvements the project team have made to the standard TGE over the past three years. A number of features of the standard TGE have been customised to meet the specific requirements of the DSE implementation. These include adjustments to the graphical user interface (GUI), terrain painting, aural immersion, artificial intelligence (AI), and 3D modelling of authentic Australian fauna and flora. Together they generate a uniquely Australian 'feel' to the game engine. They are essential for the authentic environments necessary for the accurate telling of Indigenous Australian storytelling – the DSL's primary goal. Within this

technological framework, expectations by the clients for their project outcomes are managed. The DSE has been applied in a number of different contexts: salinity mapping, spatial mapping, language, education, and storytelling. The main features of the DSE and a brief description of some recent implementations are included in this paper.

The Project Cycle

Each project follows an iterative cycle. Initial planning is done in consultation with the community. This continues throughout the project's development. A project cannot be finalised until an authentication process is completed. During site visits, with permission, members of the team may collect photographs, video, sounds, and samples of local materials, such as bird noises, grasses, and notes on and photographs of local landscape features. These are then used in conjunction with satellite and aerial photography of the region to build the toolkit. Clients provide information about what they would like to see in their simulated country, the stories, what animals are needed and so on. From this, a collection of agreed fauna and flora is modelled and animated and embedded in its 'country' of origin. A set of protocols with indigenous peoples is adopted at each stage [see 1].

Why the Torque Game Engine?

A number of game engines were evaluated by the DSL group (Unreal Tournament II, Ogre, and Halo). The popular Torque game engine (TGE) was chosen because it contained most of the features needed to develop cultural heritage artefacts in a real-time 3D environment and ownership is retained by the developers. The DSL development team have actively worked with the TGE developers' community to make improvements to the base engine that suit our specific needs.

DSE Improvements to the Standard Torque Game Engine

Where the DSE implementation differs from the standard TGE is in the use of a 'terrain painting' metaphor. Terrain painting involves using bitmaps as information containers which inform the TGE where to place certain objects, behaviours, audio files, procedures and so on. Using aerial and satellite imagery, landscapes are painted with the features and components needed to create authentic scenes. The advantage in this procedure is that components can be rapidly processed in any graphics program (such as Photoshop, GIMP, or Irfan). The system developed is able to generate rich 3D vegetated landscapes

from these bitmaps. The 'terrain painting' metaphor has significantly reduced development times such that projects can be completed on budget, and on-time. The standard GUI environment has also been expanded to achieve a range of interfaces suitable for the vagaries of each project. This has involved programming a more flexible and extensible range of in-game GUI components used to support a number of multimedia tasks, including audio-video playback and rich media pop-ups such as, the display of 3D objects, a picture viewer with zoom and pan, and panorama support.

Programming and Content Development

Development of the DSE's programmed features and its content are two separate production processes. The content development team develops those components that need to take into account community consultation, authenticity and so on. They include the creation of the correct plants, animals, camp lay outs, and so on. The engine development team, on the other hand, works on optimising the engine to support the content development team. The content development team feeds information back to the engine development team on potential further optimisation strategies as part of the DSE evaluation cycle. The engine development team also follows a charter for an engine that has wider implications than that necessary for virtual heritage projects alone. The separation of content and engine development has assisted in the overall efficiency of each production run.

Key Features of the DSE

The key features of the TGE developed, and extended by the DSE using the terrain painting method, for cultural heritage authenticity includes:

1. *the use of SpeedTree® for the foresting of specific regions in accordance with GPS and satellite imagery;*
2. *audio functionality, localised sounds, such as birds, grasses, winds, and so on;*
3. *artificial intelligence (AI), for controlling behaviours and interaction with users; and,*
4. *the modelling process, based on biological research specific to Australian fauna and flora.*

These features assist the ability to rapidly produce authentic and functional scenes.

SpeedTree

SpeedTree allows for the rapid production of forested terrain. SpeedTree is used in conjunction with the terrain painting process. The engine uses these bitmaps to generate

the environments. As discussed earlier, the terrain painting metaphor is used to procedurally generate the environments guided by layers of bitmap information that can be easily generated from data from either satellite or aerial images. As the generators are 'seeded' the same results are achieved each time the program is executed.

Audio Functionality

The core DSE ambient audio environment consists of more than 150 individual sound files. At 40 Mbs, it typically includes the ambient sounds of 77 large birds, 63 smaller birds, 6 frogs , 6 crickets, and wind, among others. Sounds are placed in the scene using the terrain painting system described earlier. This is further enhanced by an audio quilt system – an 'audio effect' version of the terrain painting method.

The audio quilt system divides the scene space into a series of cells recreating region-specific sounds. The cellular format allows specific actions to be performed in relation to an avatar's movement through the various cells. It uses a 'checkerboard' quilt design method to adjust the surrounding cells' audio arrangements – both density and 3D location within constrained random variables. Audio files are randomly selected from a sound bank and used to aurally populate the surrounding cells. The type of audio assets used to populate surrounding cells is dependant on the time of day and any additional required parameters. This audio ambience 'blanket' follows the user as they move around the environment, selecting random sounds as it goes. What is outside a predetermined radius is culled to reduce CPU overhead. The time of day is coded to create animated effects, such as the sun moving over the sky, and different bird sounds for the morning and evening (an important and recognisable feature of the Australian outback)

Artificial Intelligence

The standard TGE has been extended to support stronger AI. For example, the Non-Player Character (NPC) class was developed so that characters in the scene could be driven by the program rather than users. The NPC class allows the creation of statements about content creation beyond the normal array of behaviours and animated objects in a scene. The NPC class extends the standard TGE AI class. For example, in the standard TGE an animal's normal AI includes a model that informs what the animal should look like and describes how it should behave. This is done for each different type of animal (Kangaroo, Eagle, Goanna, and so on). The NPC class, on the other hand, is written once for all NPC-linked objects or characters. All animated models can then use

the NPC class to create more detailed specific instances of behaviours for a particular event which reacts to user input and presence.

NPC-controlled animated models are important in creating specific behaviours necessary for concise storytelling such as, Kangaroos moving off in unison, birds flocking, and so on. They can be the behaviours of animated humans or animals. They make the experience of 'being in' the 3D environment more real, thus memorable [2, 3, 4].

Modelling

A range of Australian fauna and flora artefacts have been modelled in as realistic a manner as possible. The biological details of each individual creature or plant has been researched to make them as life-like as possible. While new animated models are always being created, a core set of animated objects has been amassed that allows the rapid generation of realistic populated environments. Each region has specific requirements for types of fauna and flora. Most modelling occurs in Maya or LightWave. Models are then exported as a dts file (native Torque file type). Some objects may be modelled in one package and animated in another. Models are imported into the DSE and are either replicated using the terrain painting process (such as for trees, rocks, grasses, sounds, and so on) or have AI assigned to them (such as for people and animals). The accuracy and authenticity of this process is paramount in providing for a convincing populated simulated natural environment.

Recent Digital Songlines Game Engine Implementations

Among other implementations the four most recent, advanced, DSE applications include:

1. *Virtual Warrane – a virtual simulation of Sydney Cove prior to white settlement in Australia;*
2. *The artist, Vincent Serico's world - focusing on his paintings in the Carnarvon Gorge region (north Queensland);*
3. *The Aboriginal educationalist, Irene Ryder's world – focusing on narratives of bush tucker and the camp life of the Gunggari peoples (north Queensland); and,*
4. *Virtual Australia – a region showing simulated degradation of the land over time due to rising salinity (Western Australia).*

Virtual Warrane has been modelled on Sydney Cove prior to white settlement (see figure 1). Early maps and paintings were used to recapture the landscape as it was in 1770.

Combining satellite imagery and DEM maps, the cove has been extruded and repopulated with native fauna and flora appropriate to that time. It includes quests, and kayaking adventures on the bay. Quests provide a 'hands on' approach to learning traditional hunting and gathering techniques as well as gaining an insight to the lore and mythological beliefs of the local Cadi peoples. This implementation features a text-based knowledge dissemination system. Knowledge is gained through interaction with simple conversation tree style chats with world NPC's.

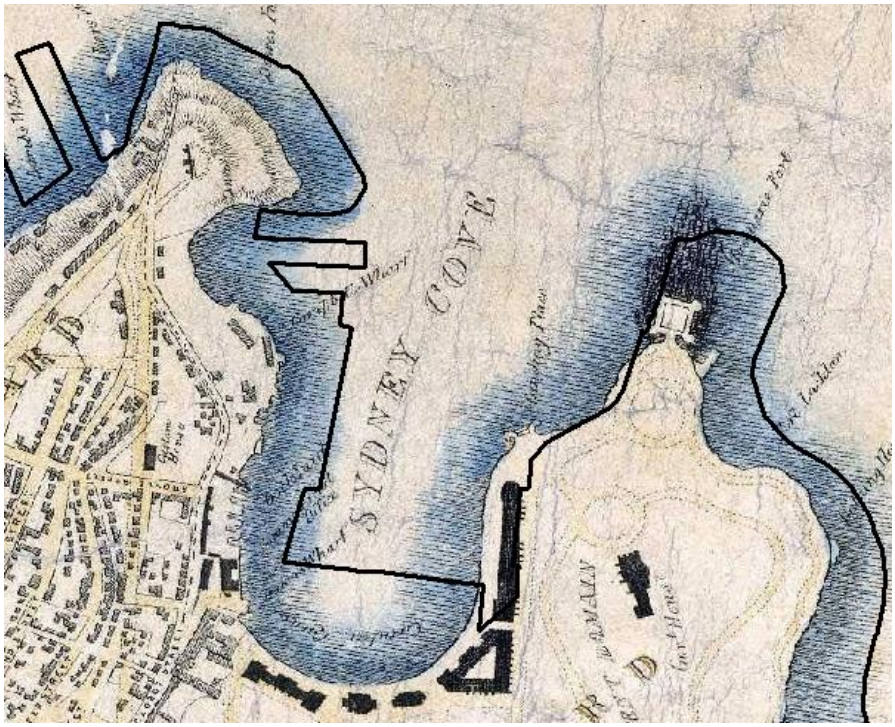

Figure 1. *Sydney Cove in 1840 with modern coastline overlay used in Virtual Warrane.*

Vincent World is modelled on the Carnarvon Gorge region in northern Queensland. Vincent Serico is an Aboriginal artist of high acclaim. In the DSE application, several of Vincent's paintings are located in the places that are referred to in the paintings themselves. Once the user is in that region they can right-click on an icon and one of Vincent's paintings will pop up (see figure 2). They can then select an area of the painting to see and hear Vincent talk about his painting and life in that region (as an audio-visual popup).

Figure 2. *Screen grab of Vincent Serico's World showing a painting embedded in the game interface.*

Irene World includes a bush tucker walk (edible indigenous fauna and flora). Irene narrates the introductory walk to the landmark Gunggari peoples' camp or Yumba (in the Mitchell region of north Queensland)(see figure 3). Irene talks about the black goanna – the significant totem animal for the people of that region. Once in the camp, the user can wander around and interact with various objects learning more about traditional aboriginal crafts of survival with a voiceover by Brett Leavy and individual pronunciation hyperlinks in pop-ups for aboriginal words in the local dialect. Beyond the camp, inter-actors meet many different hunting and gathering learning scenarios and guides.

Figure 3. *Screen grab of Irene's World showing the Gunggari peoples' camp or Yumba.*

Virtual Australia was developed in conjunction with the CRC for Spatial Information (CRCSI); a joint project with the University of Melbourne. It models a region of the West Australian wheat belt. More specifically, a location near Toolabin in Western Australia. The Toolabin region suffers from rising salinity levels due to poor farming practices over the past century. It demonstrates representative assumptions of what the land could look and sound like (no birds near salt pits for example) due to the continuing increasing levels of salinity over time (see figure 4). Users can experience the simulated changes in realtime using a slider and move about the region to see different effects on different types of terrain.

Figure 4. *Screen grab of Virtual Australia, a joint project with the CRC for Spatial Information Melbourne, Australia, showing a wheat field simulation in the Toolabin region to demonstrate rising salinity levels due to poor farming practices.*

Each of these projects have required different techniques to achieve their respective client demands. They also demonstrate the flexibility of the DSE to be used in traditional and non-traditional digital storytelling formats.

Conclusion

This paper outlines the enhancements the DSE has made to the standard TGE over the last 3 years. These were made in conjunction with support from the TGE developers forum. The enhancements were necessary to achieve the goals of the DSL charter – to provide an accurate and affordable solution for Indigenous storytelling in consultation with the various groups engaged. It also outlines, in detail, the improvements made including: Speedtree, audio, AI, and modelling, and how most of these are applied using the terrain painting method. The four recent implementations provided as examples demonstrate the effectiveness and flexibility of the DSE to-date. More and more detailed, fully-featured, DSE implementations are being developed to meet the increasing demands by Indigenous groups to preserve, maintain and pass on their knowledge using this platform. The need to provide an accurate and affordable Indigenous Australian cultural knowledge is paramount as non-Indigenous cultural values continue to displace

traditional. This will benefit both the Indigenous and non-Indigenous peoples of Australia alike and world cultural heritage in general.

Acknowledgements

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Creating an Authentic Aural Experience in the Digital Songlines Game Engine: part of a contextualised cultural heritage knowledge toolkit.

Craig Gibbons[1], Theodor G Wyeld[2], Brett Leavy[3], and James Hills[4]

[1,2,3,4] Australian CRC for Interactiondesign, ACID, Australia

{Gibbons, Wyeld, Leavy, Hills} craig@acid.net.au

[2] IEP, ITEE, Queensland University, Queensland, Australia

{Wyeld} twyeld@itee.uq.au

[3] Cyberdreaming, Queensland, Australia

{Leavy} brett@cyberdreaming.com.au

[4] Silicon Graphic Incorporated, Queensland, Australia

{Hills} jamesh@sgi.com

Abstract

Digital Songlines is an Australasian CRC for Interaction Design (ACID) project that is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge. The project explores the areas of effective recording, content management and virtual reality delivery capabilities that are culturally sensitive and involve the indigenous custodians, leaders and communities in remote areas of the Australian 'outback'. It investigates how players in a serious gaming sense can experience Indigenous virtual heritage in a high fidelity fashion with culturally appropriate interface tools. This paper describes a 3D ambient audio quilt designed and implemented specifically for the Digital Songlines software, which is built using the Torque Game Engine. The audio quilt developed provides dynamic ambient fauna and flora sound effects to represent the varying audio environment of the landscape. This provides an authentic contextualised interesting aural experience that can be different each time a location is entered. This paper reports on completed and ongoing research in this area.

Introduction

The Australasian CRC for Interaction Design (ACID) is a collaborative research organisation formed with a number of universities and industry partners. The Virtual Heritage program is a research program under the auspices of the ACID organisation. The digital Songlines project within the Virtual Heritage program is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge across Australian communities, cultural institutions and commercial businesses [2, 3, 9].

The project objectives are to protect, preserve and promote Australian Indigenous culture, its practices, myths and legends, expanding and re-vitalizing a culture through the visualization of its most prized asset – the land. The project has developed the Digital Songlines software with a virtual landscape encapsulating cultural information, oral histories and mythological stories, based upon the eternal sense of land and spirituality understood by the Aboriginal people of Australia, where feeling, knowing and touching the country, kin and spirit can be experienced. Research to-date has focused on investigating how virtual worlds can capture the spirituality, culture and heritage of Indigenous people and impart these in an empathic way so that non-indigenous people throughout the world can understand the significance and cultural heritage of these areas.

Part of the emphasis on providing a simulated contextually accurate experience of indigenous knowledge is the need for an authentic aural experience within the virtual environment. This paper reports on a 3D ambient audio environment designed and implemented in the Torque Game Engine used in the Digital Songlines software. The audio environment attempts to simulate a dynamic aural environment that might be experienced in an Australian 'outback' landscape.

Limitations of Current Ambient Audio Technology

Ambient audio in most current game engines is represented by either a location based looping soundtrack or by placing static 3D audio emitters around specific nodes of interactivity [1, 4, 5, 6, 13]. The design of a looping soundtrack needs to be careful considered so it appears as "dynamic" or randomised.sound, and not a loop [7, 8, 10, 11, 12]. For example, when moving through different terrains the user should notice a change in ambient sound levels; a wooded area should sound more alive with wildlife than a sparse terrain. Careful placement of 3D audio objects can significantly enhance the users experience with aural characteristic unique to each area (see figure 1).

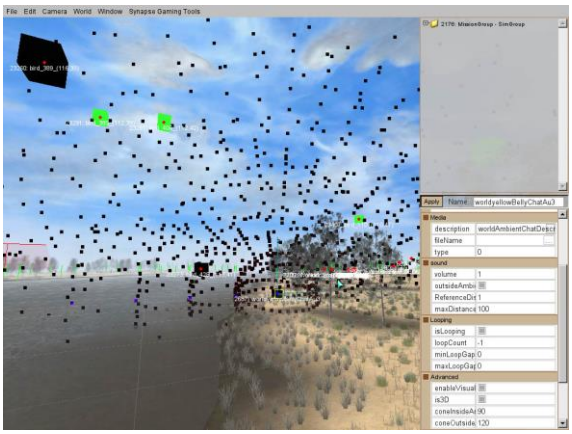

Fig. 1. *3D audio emitter in the Digital Songlines Torque Game Engine environment.*

Collecting Appropriate Audio Assets

Providing the user with multi-sensory awareness information – visual, aural, and tactile (interactive) – achieves a believable landscape simulation experience. With the importance of the audio aspect of this virtual landscape experience in mind, the ACID Indigenous Communities project team embarked upon the collection of a variety of authentic audio 'assets' to be used to aurally contextualise a culturally and place-specific 3D virtual environment. A number of locations were identified as suitable. The location reported here is in the remote north-east of Australia. In August of 2005, a field research trip was undertaken to western Carnarvon Gorge in Central Queensland, Australia. The purpose of this trip was to capture the visual and aural environment for incorporation into the Digital Songlines software environment.

Reflections on the Remote Site Visit: Carnarvon Gorge

As Carnarvon Gorge is a remote area it presented a different aural experience to the urban environment commonly experienced. Most notable was how astoundingly quiet the area is. Such was the extent of this void of sound that quiet sounds, normally obscured through aural masking and filtering, were much more audible. The sound of footsteps on the terrain type being traversed – grasses, leaves, or rocks – could be clearly differentiated with distinct audio differences. These footsteps were capable of dominating the listeners' audio environment during quiet periods of the day, and could be heard from some distance.

Due to the relative quietness, the acoustic horizon appeared to be much closer than in urban settings. Distant sounds could be heard with greater clarity and definition. For

example, the human voice, under certain conditions, could be understood at distances of approximately half a kilometre.

This notion of a closer aural horizon is due to the acoustic properties of the aurally thinner air space in rural environments as there are significantly less audio sources within the listeners' personal sound field. This reduction in aural density results in distant sounds appearing much closer to the listener. It also provides a perception of distance through the subsequent density of reverberation of the audio source. This raises the question, "how to capture and represent this aural sensation in the Digital Songlines environment?"

Capturing an Authentic Aural Experience

It became apparent, after reviewing the aural landscape and many audio recordings and notes of the Carnarvon Gorge area, that a better audio mechanism was needed than the current looping ambient systems supported by most game engines in order to dynamically represent the aural landscape. We noted how dynamic the aural soundscape changed through different times of the day. Also that, upon returning to an area, even at the same time of day over a number of days, the soundscape seemed to have changed in a number of subtle, yet noticeable, ways – as birds moved, crickets started or stopped, and so on. With this in mind, a new method was developed utilising the existing Digital Songlines Engine (DSE) technology to create this dynamism.

Implementing a 3D Ambient Audio System in the DSE: Phase 1

To attempt to capture the aural sensations recorded at Carnarvon Gorge a system for dividing the virtual world space into a series of cells was used. This allowed specific actions to be performed in relation to an avatar's movement through the various cells. The system developed uses a "checkerboard" quilt design methodology with cells monitoring an avatar's movement throughout the virtual landscape. Upon entering, each cell adjusts the surrounding cells' audio arrangements – both density and 3D location within constrained random variables. Audio files are randomly selected from a sound bank and used to aurally populate the surrounding cells. The type of audio assets used to populate surrounding cells is dependant on the time of day and any additional required parameters (see figure 2).

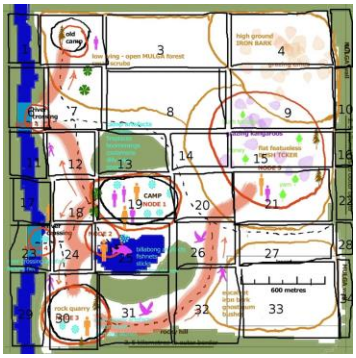

Figure 2. *Checkerboard quilt layout of region-specific audio cells.*

The first iteration of this system was evaluated within the project team. Not surprisingly, it proved to be better than what was previously used within the DSE (the looping ambient schema). However, once 3D models and characters were added to the scene, the overhead was too great, resulting in poor performance for both sound and graphical components. Also, difficulty with other animated models within the world, such as birds and non-player characters (such as a human or animal bot in the world that runs on AI and not controlled by a user) through the system triggering these squares. A solution needed to be found that would address these issues.

Implementing a 3D Ambient Audio System in the DSE: Phase 2

With the problem of the unacceptably high overhead caused by the first iteration of this system and the triggering action of other objects in the scene, a revised system was developed which leveraged the capacity of the DSE's bitMap code functionality. BitMap codes are usually used for the population of vegetation, specifically grasses, within the DSE world. For example, a bitMap code is used to analyse a prepared .png overlay on the map to determine what type of grass and level of density is needed to populate a specific region.

We used this semi-random assignment feature of the bitMap code using audio assets in place of models and textures. By implementing the bitMap code for audio, within a controlled radius of the client machine avatar, the ambient audio quilt could be "generated" in real time from a similarly pre-prepared .png overlay. No actual sound generation was taking effect, as every sound was sourced from the prepared sound bank. What was being generated was an algorithmically generated density, placed in a 3-axes coordinated system with a high level control achieved.

For example, we could place a group of frogs around a water source. We could control the density of sounds, yet the computer dealt with where to place the objects, which

sound file to use (from the given sound bank), and randomly constrain their placement within the x y z axes.

The use of the bitMap code functionality reduced the overall overhead and made the DSE navigable again. With this implementation, the ambient audio system can be used for dealing with populations of large and small birds, crickets and frogs on the map, among other collections.

Moving around the map gives one the illusion of different aural soundscapes. When returning to a region, the density and placement of subsequent audio emitters may have changed due to the random nature of the algorithmic system, generating the desired different aural soundscapes.

The system is extendable to handle any additional audio materials, with unique density and placement logic for the algorithms to process and deal with. Combined with looping area effects (such as wind), DSE's Ambient Audio Quilt provides a more accurate aural representation of the landscape than existed under the standard TGE technology.

Conclusion

The latest iteration of the audio quilt provides for an authentic aural experience in the DSE. This forms a critical part of a highly contextualised cultural heritage knowledge toolkit. The importance of contextualising the stories gathered from the community elders is paramount in addressing the sensitivity of their telling. A key tenet of the project is to protect, preserve and promote Australian Indigenous culture, its practices, myths and legends, expanding and re-vitalizing its culture through visualization in a 3D virtual environment. As such, the audio quilt project helps contextualise the virtual landscape with an authentic soundscape where feeling, knowing, touching, and hearing the country, kin and spirit can be experienced.

Acknowledgements

This work is supported by ACID (the Australasian CRC for Interaction Design) established and supported under the Cooperative Research Centres Program through the Australian Government's Department of Education, Science and Training.

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Further Publications

Leavy, B., Hills, J., Gard, S., and Wyeld, T. G., 2006. Accessing Aboriginal Cultural Heritage using a GIS supported Game Engine Interface: Some Preliminary Findings: In proceedings of CTTSC06, Cairns, Australia.

This paper will discuss a proof-of-concept Aboriginal Knowledge practice database that uses the Torque game engine as its user interface. The Digital Songlines project (DSE) was formed in 2003. It includes arrays of 3D objects used to recreate a landscape populated by Aboriginal flora and fauna. An established mechanism to import digital terrain models existed and it was modified for importing satellite based geo-spatial data, or data that is prepared for use in GIS software, for accurately mapping the cultural heritage landscape including ancient rock art. The terrain data in vector or raster based formats is layered with spatial attributes that identifies where the features are located in geographic space as relevant to Aboriginal cultural heritage. The geo-spatial data includes various files that make up a cultural metafile set with vector data representing trade routes (Songlines), a table containing the artifacts belonging to significant places. These are positioned correctly in the 3D world using GPS. Flora and fauna were surveyed and photographed on-site and modeled for inclusion in the environment. Preliminary evaluation with numerous Aboriginal communities indicates its potential for not only leading to the training of community members in digital media, but also providing a cultural focus for the sharing of knowledge practices between generations. While the primary use of the tool has been in the area of cultural history, a wide range of potential educational installations have been identified including: museums, science centres, cultural centres, interpretive centres, community consultation, local councils, forestry, water resources, development organisations, schools, mining, safety training, media and data fusion capabilities.

*Leavy, B., Hills, J., Barker, C., Gard, S., Wyeld, T 2006. Digital Songlines - Digitising the Arts, Culture and Heritage Landscape of Aboriginal Australia: Presented at **New Heritage Forum**, Hong Kong.*

Digital Songlines is an Australasian CRC for Interaction Design (ACID) project that is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of Aboriginal cultural heritage knowledge. This research will illustrate significant Australian Aboriginal spaces such as the Mt Moffatt area at Carnarvon Gorge in south-west Queensland and areas around the Pilbarra in Western Australia. The project explores the areas of effective recording, content management and virtual reality delivery capabilities that are culturally sensitive and involve the Aboriginal custodians, leaders and communities in those areas as well as how players in a serious gaming sense can experience Aboriginal virtual heritage in a high fidelity fashion with culturally appropriate interface tools.

Adkins, B., Pumpa, M., truna aka j. turner., 2006. Indigenous Knowledge Aboriginal Knowledge as Re-enchantment - the case of the Digital Songlines Environment: Presentation at Indigenous Knowledges Conference, Gold Coast.

The Digital Songlines project involves the development of a 3-D digital environment for the representation of Aboriginal cultural knowledge, practices and languages. In this context, what should be the purpose of acquiring "knowledge about Aboriginal knowledge" which is required to inform the design of the environment, and for what purposes should it be embedded? This paper proposes that a key rationale might be found in the context of the thesis of the "disenchantment" of the world: the outcome of

Western development involving the disembedding of the fields of economics, politics etc from their traditional context in religious, mythical and ethical systems. The concept draws attention to the idea that domination was never merely power over a group, but also the relationship of shared meanings between people that served the interests of power. This paper discusses the questions: Can and should the Digital Songlines environment be understood and developed as a tool for "re-enchantment", and what forms will this "re-enchantment" take?

Gard, S., Bucolo, S., and Wyeld, T. G., 2006. Capturing Australian Indigenous Perceptions of the Landscape: Virtual Environments with Cultural Meanings: In proceedings of ALLC Paris, Sorbonne.

The Digital Songlines project differs from the approach taken by most others in the field of virtual heritage. While there are many examples of recreated cultural sites, most of them are of a built form, such as temples, monuments, cities and townships. They are frequently re-created in 3-dimensions with a high level of realism. On the other hand, the Digital Songlines project's focus is on more than simple visualisation, rather its mission is to recreate an experience; a way of interacting with the simulated environment by identifying the key elements give to each place and its special cultural significance that an Aboriginal group identifies as being within their own tribal boundaries. Integrating the key cultural elements in a synthetic environment goes some way towards providing a setting for exploring otherwise inaccessible or previously destroyed significant sites. While traditional virtual heritage reconstructions frequently depend on technological solutions, Digital Songlines depends more on an understanding of the traditional cultural values attached to specific landscape by the participating Aboriginal people and then on a methodology and process for integrating those values in the digital environment with a focus on cultural relevance independent of its level of visual realism.

Pumpa, M, and Wyeld, T. G., 2006. Database and Narratological Representation of Australian Aboriginal Knowledge as Information Visualisation using a Game Engine: In proceedings of IV06, London, England.

This paper challenges current practices in the use of digital media to communicate Australian Aboriginal knowledge practices. It proposes that any digital representation of Aboriginal knowledge practices needs to examine the epistemology and ontology of these practices in order to design digital environments that effectively support and enable existing Aboriginal knowledge practices in the real world. Central to this is the essential task of any new digital representation of Aboriginal knowledge to resolve the conflict between database and narrative views of knowledge. This is in order to provide a tool that complements rather than supplants direct experience of traditional knowledge practices.

Gard, S., and Wyeld, T. G. 2006. Modeling the Aboriginal Rock Art of Mt Moffatt: In proceedings of CTTSC06, Cairns, Australia.

This paper introduces the method used to produce a 3D model of an Aboriginal Rock Art Cave for inclusion in a synthetic environment using the Torque game engine as its user interface. The site chosen for this is an area called The Tombs in the Mt Moffatt section of the Carnarvon Gorge National Park. This paper will report on the processes and outcomes of this project in the context of preserving and enhancing aboriginal cultural heritage.

Pumpa, M, Wyeld, T. G., Adkins, B., 2006. Performing Traditional Knowledge

using a Game Engine: Communicating and Sharing Australian Aboriginal Knowledge Practices: In proceedings of ICALT2006, Kerkrade, Netherlands.

This paper challenges current practices in the use of digital media to communicate Australian Aboriginal knowledge practices in a learning context. It proposes that any digital representation of Aboriginal knowledge practices needs to examine the epistemology and ontology of these practices in order to design digital environments that effectively support and enable existing Aboriginal knowledge practices in the real world. Central to this is the essential task of any new digital representation of Aboriginal knowledge to resolve the conflict between database and narrative views of knowledge [5]. This will be in order to provide a tool that complements rather than supplants direct experience of traditional knowledge practices [2]. This paper concludes by reporting on the recent development of an advanced learning technology that addresses this.

Gard, S. & Bucolo, S., 2005. Capturing Australian Aboriginal Perception Of The Landscape: Virtual Environments With Cultural Meanings: In proceedings of VSMM2005, Ghent, Belgium.

This paper presents a means of capturing non spatial information (specifically understanding of places) for use in a Virtual Heritage application. This research is part of the Digital Songlines Project which is developing protocols, methodologies and a toolkit to facilitate the collection and sharing of Aboriginal cultural heritage knowledge, using virtual reality. Within the context of this project most of the cultural activities relate to celebrating life and to the Australian Aboriginal people, land is the heart of life. Australian Aboriginal art, stories, dances, songs and rituals celebrate country as its focus or basis. To the Aboriginal people the term "Country" means a lot more than a place or a nation, rather "Country" is a living entity with a past a present and a future; they talk about it in the same way as they talk about their mother. The landscape is seen to have a spiritual connection in a view seldom understood by non-Aboriginal persons; this paper introduces an attempt to capture such empathy and relationship and to reproduce it in a virtual environment.

Research in Australian Aboriginal Virtual Heritage

The outcomes of the Aboriginal Communities project and the Virtual Heritage Program, is the software application titled Digital Songlines and the design of an innovative application and toolkit for presenting Aboriginal knowledge. The form by which such knowledge could be recorded is through multiple media formats like oral histories, film clips, photographs, written knowledge, language, activities and dance for the purpose of presenting this knowledge in context of a virtual landscape where this knowledge stems. DSE as a toolkit seeks to depict traditional and contemporary knowledge about culture and heritage using this metaphor of a virtual landscape because Aboriginal cultural heritage is seem to be transferred in a three dimensional world, where traditional owners or storytellers depict their close connection to their traditional lands.

Image 3 - *This image is a screen grab from Irene's World; a project designed in partnership with Irene Ryder and the Gunggari Community of South West Queensland. This image shows the yumba and campsites which were placed as accurate as possible to the correct location of this site in reality.*

Lon Addison argues that virtual heritage and United Nations Environmental Scientific and Organisation (UNESCO) programs have the potential to benefit from the adoption of new media technologies and methods for recording and preserving cultural heritage.

DSE adopts this view too and is exploring through a number of pilots like Irene's World and Virtual Australia, methods that will permit Aboriginal communities across Australia to have a means and set of techniques that preserve, protect and disseminate their cultural heritage knowledge in more rich, accurate, authentic and respectful ways that acknowledge regional differences. As Image 3 of Irene's World shows the potential of recording precisely sites of cultural significance and the placement of "yumbas" and cultural techniques can be presented accurately and authentically when an Indigenous community champion is engaged in the process – in this case Irene Ryder an elder of the Gungarri people.

Potential benefits to be explored in this thesis of adopting virtual heritage tools and technologies include:

1. *A means to support selected traditional owner groups across Australia and assist the recording of their cultural heritage knowledge;*
2. *Can support partnerships with appropriate groups in a traditional knowledge territory for this purpose that supports digital cultural heritage preservation;*
3. *Facilitation of community job plans and training strategies in cultural heritage management;*
4. *Aboriginal knowledge is collected and preserved following criteria which meet the requirements of an Aboriginal Research Framework;*
5. *The collection, collation and preservation of local Aboriginal language and the support existing language programs;*
6. *Content collected using the DSE to support video and radio distribution;*
7. *Support for working relationships with existing regional Aboriginal knowledge centres, telecentres, libraries, language centres, land councils, regional computer access centres or tourism services;*
8. *Facilitation of commercially viable exploitation of Aboriginal cultural heritage knowledge based upon the community determination and empowerment; and*
9. *Caters for the needs of both the Aboriginal communities and the requirements of government and corporations who require cultural heritage mapping services.*

Legal Frameworks and Protocols for DSE

Before any community engagement strategy could be attempted there needed to be a set of protocols to manage and assist researchers engage with communities. A protocol methodology was commissioned by ACID and CyberDreaming to establish a set of

guidelines as well as to assist with the collection, collation and treatment of Aboriginal knowledge.

These guidelines provide a methodology for, communities, and organisations to follow when engaging with Aboriginal communities that the DSE project could adopt. These guidelines are a means by which the United Nations Environmental Scientific and Organisation (UNESCO) sought ways to support and facilitate the recognition and respect of the diverse cultures and heritage of communities throughout the world. UNESCO's formal approach resulted in the implementation of international conventions. Including the Convention for the Protection of the World Cultural and Natural Heritage in 1972 which advocated a further convention titled A Global Strategy for a More Representative World Heritage List. Further research is needed to ensure that DSE adopts this convention into the basis for its national digital inventory recording processes as applies this methodology to the depiction of Australian Aboriginal cultural and natural heritage.

Furthermore, UNESCO adopted another Convention for the Safeguarding of Intangible Cultural Heritage passed in 2003. This Convention has called for State Parties to draw up inventories of intangible cultural heritage that exist in their regions (article 12) and again another Convention for the Protection and Promotion of the Diversity of Cultural Expressions passed in 2005, required State Parties to implement policies and measures aimed at supporting public cultural institutions (article 6 f). A UNESCO World Heritage Site is a specific site (such as a forest, mountain, lake, desert, monument, building, complex) that has been nominated and confirmed for inclusion on the list maintained by the international World Heritage Program administered by the UNESCO World Heritage Committee, composed of 21 State Parties (countries) which are elected by the General Assembly of States Parties for a fixed term.

In developing DSE for the purpose of digitally document in 3D using simulation software Australian Aboriginal heritage projects, researchers need to adhere to such UNESCO defined and negotiated international conventions which set out international standards for Aboriginal cultural heritage management. Recorded within these conventions are the internationally accepted principles relating to how the AIVH discipline could progress respectfully and what protocols should be followed to assist the process of recording, preservation and presentation of Australian Aboriginal cultural heritage.

In summary, DSE has adopted these principles to ensure:

1. *That any researchers recognize the custodians and traditional owners in the country where the DSE development happens. Respect must be given to traditional owners who possess the custodial role and expert knowledge in relation to their cultural heritage and the management of the same. The researcher needs to consult with the traditional owners, through the appropriate representative bodies that represent traditional owners, and afford the opportunity to negotiate resolutions in keeping with the custodial role with any third party ahead of any action being undertaken;*
2. *That the traditional owners are recognised and that DSE may not provide commercial results and that any schedule imposed in terms of design and development of programs and production might not minimize costs of the investment. DSE team of designers and developers, through the assistance of traditional owners, need to use their best endeavours to assist community in meeting schedules, and work with the DSE team members to achieve outcomes in a timely manner;*
3. *All negotiations must be undertaken with care and respect to the culture and existing community structures (e.g. family, administrative and incorporated organisations, social and economic, etc) that exist in any community of operation; and*
4. *That the expert knowledge of the Traditional Owners, customs, traditions and Native Title Rights are vested in the community and ancestral traditions respected. This is an essential element of any application of DSE when any development and treatment of Aboriginal knowledge occurs.*

Research in the DSE project with the pilot communities like Gunggari, Juluwarlu and Kooma showed that community people do have the propensity and the ability to use ICT tools to document in a visually realistic way, the diversity of cultural heritage. Feedback from the demonstration of these projects at the Dreaming Festival at Woodford in 2005 showed that communities who participated could manage and use the tools for the preservation, protection and presentation of their culture, language, arts and heritage. The general feedback was positive from the visitors to the exhibit and surveys revealed that many non-indigenous people felt that virtual heritage had potential to present Aboriginal knowledge in an enduring and engaging fashion that appeared authentic, informing and entertaining compared to standard methods like books, radio and television.

Feedback from Community Engagement and Demonstrations of DSE

The research, evaluation and demonstration of the DSE project succeed mainly due to the community engagement process. This process also assisted the iterative design and

development of the various iteration of the DSE application. Three communities and over 1,000 Indigenous people gave advice that was adopted into the Aboriginal Communities program. This feedback is outlined in the following round-up. In summary, the DSE project received widespread support from the Aboriginal and non-Aboriginal community whenever it was demonstrated and each demonstrated reinforced its central purpose as an application for cultural heritage management. What is shown below is that the advice and feedback from various communication help guide how the application was designed, technical enhanced and how the cultural heritage content was presented.

Gunggari , South West Queensland– May 2003-2007

The Aboriginal Communities project adopted a community consultation process to ascertain the community acceptance of a 3D toolkit for Aboriginal knowledge management to document traditional owner cultures and values. It was fundamental then as it is today adopts the appropriate community engagement principles in treating the presentation of cultural heritage knowledge in the most appropriate ways.

In consultation with the Gunggari community, many people raised concerns about DSE in that it needed to:

1. *ensure direct traditional owner involvement in the development and implementation of the DSE applications;*
2. *maximise direct Traditional Owner management of and involvement in all management actions deemed necessary to protect and minimize the impact of development on traditional owner culture and heritage values in the proposed development areas;*
3. *protect to the fullest extent possible those traditional owner cultural heritage values which exist in the proposed development areas; and*
4. *allow the proponent to fulfill its commercial and corporate obligations while assisting in the protection of all traditional owner cultural heritage values which exist in the proposed development areas.*

Researchers adopted these concerns into future developments (DSE software development for Irene's CD-ROM).

Juluwarlu, Pilbara, Western Australia – October 2004-2006

In October 2004-2006, a project was proposed to ACID by Murdoch University in partnership with the Juluwarlu Community. This project sought to adopt the DSE for

digitizing the cultural heritage for this Aboriginal community. The Author travelled to consult with Juluwarlu Community in late 2006 and during meetings the community raised concerns about their Aboriginal knowledge and how it would be licensed and potentially commercialized. The meeting also covered issues regarding the exploitation of their Aboriginal knowledges and the intellectual property and copyright relating to Aboriginal knowledges.

Image 4 - *This image is a taken from the journey to a very significant site for the Juluwarlu community. The gentlemen are holding dinner for the evening in Roebourne.*

Systems for Participatory GIS were also discussed and how a community based 3D database system, if adopted, should adhere to world heritage metadata recording standards. Additionally the Aboriginal community needed to be consulted in any designed interface so that this respects the Aboriginal sensibilities, adapts to their needs and integrates dynamically into robust and user friendly solution for digital storytelling. (This issue was raised by the Juluwarlu Media Development Unit).

Furthermore, the enactment of PGIS needs preparation, assembly, technical resources within communities, new processes to be accepted by communities for depicting their sensitive information, how to manage data extraction, collecting of content like digital photography, GIS processing, map production and data validation.

The Juluwarlu Project has yet to be completed.

Boorooloola, Arnhem Land, Northern Territory – June 2005-2006

In June 2005, DSE was presented at the Dreaming Festival. During the presentation a number of researchers from Monash University and other gave considerable insight as to the viability and potential importance of the project. Many comments related to how DSE might provide community people with the ability to use ICT tools to document in a visually realistic way, the diversity of cultural heritage.

People who visited the displays during the Dreaming and Woodford Festivals stated that by allowing communities to participate and therefore to manage the preservation, protection and presentation of their culture, language, arts and heritage would add greatly to the authenticity of knowledge and that the outcome would be seen by the general public as enduring, more realistic and intrinsically valuable.

Image 5 - *This image is a taken from the tent set up to display the Irene's and Vincent's Worlds at the Dreaming Festival in Woodford in July 2006 in which over 3,000 people were able to interact with the display and actively engage in the Australian Aboriginal Virtual Heritage experience.*

There was a presentation to Boorooloola Elders during the course of the Dreaming Festival and this was where the reference to a Dictionary of Arts and Culture titled Forget About Flinders and was researched John Bradley and Nona Cameron.

These activities facilitated the adoption and acceptance of the DSE principles and protocols within communities.

Yugambeh, South East Queensland – February 2004-2006

Between the years 2004-2006, DSE was presented to Yugambeh Communities and other Aboriginal groups from throughout South Queensland. Issues which were raised related to how cultural heritage of these Aboriginal communities would be recorded and what process and methods should be adopted. Community representatives discussed how the actions of the State and Federal Government might use and possibly exploit Aboriginal knowledge and in doing so deny right to access and preservation of Yugambeh cultural heritage.

They advised that the ACID Program should explore the context of the Aboriginal Cultural Heritage Act 2003, an Act which commenced on 16 April 2004 as legislation developed to bind all persons, including the State, to the provision of effective recognition, protection and conservation of Aboriginal cultural heritage.

The following fundamental principles underlie the Act's main purpose:

1. *the recognition, protection and conservation of Aboriginal cultural heritage should be based on respect for Aboriginal cultural and traditional practices;*
2. *Aboriginal people should be recognised as the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage;*
3. *it is important to respect, preserve and maintain knowledge, innovations and practices of Aboriginal communities and to promote understanding of Aboriginal cultural heritage;*
4. *activities involved in recognition, protection and conservation of Aboriginal cultural heritage are important because they allow Aboriginal people to reaffirm their obligations to "law and country"; and*
5. *there is a need to establish timely and efficient processes for the management of activities that may harm Aboriginal cultural heritage.*

These principles were integrated into the DSE community engagement practices.

Cunnamulla, South West Queensland – October 2004

The main issue raised by community members in most places visited, but in particular Cunnamulla was in regard to Intellectual Property and Copyright (IP&C) and the manner of which the university researchers could claim to possess ownership from knowledge gathered from the field research in respect to Aboriginal knowledge.

IP&C discussions are ongoing and they represent the most challenging barriers to further DSE and Australian Aboriginal virtual heritage. In the future I hope to progress these issues through further consultation, additional academic work and iterative content and software development work at Aboriginal cultural heritage significant sites across Australia.

Hopevale, Far North Queensland– July 2004-2007

Victor Hart, the manager of the Oodgeroo Unit at Queensland University of Queensland and a senior Aboriginal person from the Hopevale Community, raised concerns about the need for an Aboriginal Research Framework (ARF) whenever attempting to record, preserve and protect Aboriginal knowledge. He believed that by adopting an Aboriginal Research Framework that adhered to community and cultural protocols, followed standards of ethical action and accountability would encourage tangible dialogue. He raised other concerns about proximity of the researcher to the community and that long association with Aboriginal people who are the custodians to the land, would greatly assist the traditional knowledge recording process. He raised further issues about whether Aboriginal Knowledge could be effectively passed on to the next generation through technology and that a strong re-association with traditional and custodial rights practice is needed.

(ARF) needs to be applied to Virtual Heritage Management to ensure that Aboriginal Australians are consulted, involved in, and part of any research conducted in relation to themselves and their communities. These ARF processes ensure appropriate consultation, clarification of research ownership and control, and community involvement. Many universities and ACID adopted such guidelines for the conduct of their research to be conducted in a culturally appropriate fashion.

Aurukun, Western Cape York, Queensland – August 2005

In this community we presented Irene's World to Aurukun Elders. These Elders raised issues regarding how to recognize Aboriginal people as being as the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage.
Discussions are ongoing and relate to future community engagement and content development.

New Mapoon, Western Cape York, Queensland – August 2004-2006

Elders in New Mapoon raised issues regarding how DSE could assist activities involved in recognition, protection and conservation of Aboriginal cultural heritage. Community leaders believed it is important to allow Aboriginal people to reaffirm their obligations to "law and country" and to build functionality into the DSE system to ensure cultural heritage practices to be properly adhered to. (Recall the trip to the Turtle Beach Protection and Preservation Project).

Issues around managing identity and access to content (i.e. Stories and cultural knowledges) have been progressed and represent one area of future software development and application.

Other Meetings – August 2004- 2007

1. *Bidjara, Charleville, South West Queensland – Charleville Medical Centre meeting and Cosmos Centre presentations*
2. *Kooma, South West Queensland – Traditional Owner meetings and presentations at Murra Murra, Toowoomba and Cunnamulla*
3. *Murawari – Bourke Language Centre Interview, presentation and meetings*
4. *Mandandanji, South West Queensland – campfire Group and FireWorks Gallery interviews - Laurie Nilsen*
5. *Jagera, South East Queensland – Yugambeh Museum presentations*

Summary of Community Concerns

There are a number of concerns raised by communities during demonstrations that can be summarized in the following list:

1. *The funding and personnel limitations of the ACID research program.*
2. *Communication with the ACID Researchers and the organisation regarding the scope and requirements of the Aboriginal Communities Research objectives.*
3. *The ability of the programmers to realise software functionality in a timely manner and with appropriate Aboriginal sensibilities to design and development.*
4. *Authenticity and integrity of the knowledge being given.*
5. *The lack of resources and technical support to realise the research program objectives.*

6. *The profit motives driving the development of the application for the purpose it was intended.*
7. *Licensing issues relating to the application of the software for the purpose of Aboriginal knowledge management.*
8. *Community skill levels in being able to hit the ground running using DSE for the purpose it was intended.*

Other criticism of DSE related to the adoption of techniques related to standard geographical information systems (GIS) and whether these were advancing fast enough to be objective, value-neutral, accessible, representative, preserved privacy, confidential, ethical and more concerned with maintaining public service values rather than being community directed. Further to this, support for the development and legitimization of an alternative GIS system needed to incorporate Aboriginal people's participation in the process.

Commercial consideration for utilising the program in public policy and planning requires 'objectivity', value-neutrality, ease of access, public ownership of knowledge, democratic representation, central control, carefully treatment of privacy and confidentiality, clear ethical consideration and public service values embedded into the processing of knowledge for the greater public good.

Additionally, the interface design needed to be sensitive to cultural diversity – as well as respecting limits that the software applications could achieve. User interface design and development needed to consider Aboriginal sensibilities and integrate dynamically into other media capabilities (like video and audio capture technologies for oral histories recording).

Using the Digital Songlines Engine

The Digital Songlines Engine (DSE) implementation for immersive interactive simulations, virtual heritage and digital storytelling provides not just an educational interface, but also a means for archiving and representing the deep spiritual connection of Aboriginal people with their traditional lands.

DSE evolved as an innovative software toolkit for recording Aboriginal knowledge collected in multiple media formats (oral histories, film clips, photographs, written knowledge, language, activities, dance etc). Its purpose is the re-presentation, in context of a virtual landscape, Aboriginal knowledges and cultural heritage associated with the landscape. Deemed relevant by communities, who were shown iterations like Irene's

and Vincent's Worlds, the feedback from the demonstrations of the software, depicting traditional and contemporary knowledge about culture and heritage was well received and endorsed.

Where the DSE implementation of a game engine in a cultural heritage application differs from others is in the nature of the simulation environment. Modeled on the 'country' (the 'place' of their heritage), which is so important to the Aboriginal peoples' collective identity, and authentic fauna and flora as outlined and described in a List produced by the Australian Herbarium Society the DSE provides a highly contextualised setting for the stories to be told.

The Author argues that the metaphor of a virtual landscape, that is not just interactive but also visually perfect in every sense, is very acceptable means to present as well as preserve the knowledge, culture and heritage of traditional owners and storytellers. It was accepted that this medium can deliver their knowledge in such a manner that respects the traditions and knowledges as well as convey the close association of Aboriginal people to the landscape.

As a research project, the adoption of an iterative development system for DSE ensured that the system Incorporated means and ways to protect Aboriginal knowledge through encryption as well as adopting the best legal frameworks regarding Intellectual Property and Copyright which Terri Janke of Janke and Associates produced for the Australian Council for the Arts and ATSIC in the late 1990s. these frameworks stated:

1. *Digitalises arts, artefacts, rituals and practice appropriately;*
2. *Represents patterns of socialisation and design methods for teaching & learning;*
3. *Records and incorporates Aboriginal languages effectively;*
4. *Provides virtual worlds creation tools and designs as much realism including artificial personality, authentic audio quilts as well as accurate landform features and vegetation detail;*
5. *Provides interactivity – so as to embed ways to best preserve, protect and present Aboriginal content to help sustainable resource management, best practice in recording myths & legends and for the respect of the Aboriginal diversity;*
6. *Calculates 3D satellite topography at sites accurately;*

7. *Designs Aboriginal appropriate user interfaces and interactive styles; and*

8. *Gathers content appropriately by following the proper cultural protocols & engages in community consultation through the content gathering and design and development phases.*

Methodology and Protocols for Gathering Cultural Heritage Knowledge

There needs to be a clear and tested method for content gathering and this could follow an Aboriginal Research Framework (ARF). Furthermore the adoption of the international methods under the Public Participatory Geographic Information Systems (PPGIS) could accord the community some protection of their knowledge given that this way of operating adheres to community cultural protocols, as well as having standards of action and accountability, established over its long association with the Aboriginal people in many developing countries across the world. PPGIS is the result of a spontaneous merger of Participatory Learning and Action (PLA) methods enhances the physical tools of geo-spatial information management systems including sketch maps, participatory 3D models (P3DM), aerial photographs, satellite imagery, global positioning systems (GPS) and geographic information systems (GIS). These tools combine to compose peoples' spatial knowledge in the forms of virtual or physical, 2 or 3 dimensional maps used as interactive vehicles for spatial learning, discussion, information exchange, analysis, advocacy and decision making.

Such a process would acknowledge Aboriginal communities as the custodians of the land and require them to become actively involved in the content gathering process. As Figure 2 represents the standard content acquisition equipment a prerequisite is that Aboriginal people have the skills to use these tools and manage the output as a result of their content gathering approach. Any findings and knowledge gathered could be recognised as evidence under Australian law with respect to relationship and continuous connection to country and be applied under the Mabo Act which the National Native Title Tribunal auspices.

PPGIS would seem an appropriate methodology to adopt and adapt to the gathering and recording of Aboriginal knowledge because it allows for community engagement in the process. It was established as a world best practice and defined as a process in 1996 at the meetings of the National Center for Geographic Information and Analysis (NCGIA) and whose website is http://www.ncgia.ucsb.edu. However, what the Australian

Aboriginal Virtual Heritage discipline seeks to do is adopt the manner in which PPGIS has integrated academic practices of GIS and mapping in a local level for promoting knowledge creation and manage in a virtual way and to empower and foster the inclusion of Aboriginal Communities, who have little public policy influence, via the application of this innovative geographic technology methodology.

When PPGIS database are created this allows information collected to be applied into this system. There are plans for DSE to adhere to this system to ensure cultural heritage information is recorded and archived in adherence to world heritage metadata recording standards. Additionally the user interface design used by the community must respect Aboriginal sensibilities, be adaptable and seamlessly integrate in the oral histories and storytelling dynamic of Aboriginal communities.

Why PPGIS is relevant to AIVH is that it uses and produces digital maps, satellite imagery, sketch maps, and many other spatial and visual tools, that seem so relevant to the to change geographic involvement and awareness at the level of the local community. Furthermore, the application of PPGIS principles and process for the preparation, assembly, technical resources and means by which communities, depicting their sensitive information, manage data extraction, content collection and the treatment of digital photography, film and audio media, GIS information, map production and data validation is consistent with the manner in which such information is presented in the community based Virtual Heritage application created by the AIVH discipline.

The context in which cultural heritage information gathered from the client is used (for the purpose of environment creation) needs to be acutely different from the museums/library approach offered by existing metadata formats. The most significant difference being that capturing cultural heritage information that can be displayed in a game engine needs to each object generated within the database, to have a unique physical appearance, place and position within the digital world as it does in the real world.

For example, Image 6 represents a wedge tail eagle. This bird makes a particular bird-call associated with a Dreamtime story and has significance from a cultural heritage context. Because the bird flies it has no physical location and is not unique to one particular landscape position. Consequently, the DSE database needs to be able to store a more general selection of computer files and judiciously associate them with

cartesian space so that the relevant cultural heritage information can be associated with movement, sound and 3D space.

***Image 6** - Screen grab from Irene's World, showing the visual acuity or the sky and the wedge-tail eagle in the sky. This bird is symbolic as well as significant yurdi fro the Gunggari people.*

The Mobile Mnemonic Toolkit

The mobile mnemonic toolkit is a system for gather and capturing all relevant auditory and visual virtual heritage content and other cultural heritage transactions that occur in a community. This toolkit includes a camera, audio recorder, video recorder, GPS device and paper and a pen – all currently available technologies –used together to assist the content gathering and data sorting process.

***Figure 2** - These images represent the basic components of the mobile mnemonic toolkit which entails the video camera, digital WAV audio recorder, GPS device and digital SLR camera.*

This mobile mnemonic toolkit adopts the PPGIS that collectively provides an effective means for gathering community support and assistance to document Aboriginal knowledges. Whilst In adoption of the appropriate protocol, this ensures Aboriginal communities are engaged and confident that the work of the researchers is sensitive to

and formalized to respect and adhere to community protocol with respect to the treatment of their knowledges.

Once all the information has been gathered from the client it is then necessary, to faithfully reproduce the physical environment, narrative and actions offered from their accounts into the game-engine. To this extent, the final expression of the cultural heritage information is limited by the capabilities of the game-engine. To support a wide-range of metaphors for storytelling and information dispersion we have augmented the Torque game engine to include support for:

1. *Converting digital elevation map data (DEM) into terrain tiles like Google Earth. Google Earth is a satellite imagery, mapping, terrain and 3D building visualisation internet delivered platform created by Google to represent geographical information over the Internet. DEM data is a digital representation of ground surface topography or terrain and can also be referred to as digital terrain model (DTM). A DEM can be represented as a raster or grid o squares or as a triangular irregular network and are commonly used to create digitally produced relief maps;*
2. *Blue-screening flora and fauna into textured 3D models and randomising their placement within the environment according expected positioning;*
3. *Placement of 3D ambient audio recorded from the environment to simulate the soundscape;*
4. *Artificial intelligence system for mimicking the behaviour of animals and non-active characters in the environment. Artificial Intelligence in DSE involves the design and implementation of iterative system for 3D characters to interact in the proper context with the virtual heritage environment. This relates to evolutionary algorithms, genetic algorithms and swarm intelligence for kangaroos, flies, native bees and the like;*
5. *Photogrammetry for modelling cave-paintings and artefacts as well as motion capture to record body actions such as ceremonial dances or spear throwing. Photogrammetry in DSE relates to the use of remote sensing techniques creating realistic and accurate geometric properties relating to rock art sites and other objects of cultural significance. This technique was chosen because of its rapid prototyping possibilities and cost effectiveness; and*
6. *A flexible information pop-up system that can embed standard video, images, panoramas, audio and hyperlinked text.*

Using this range of capabilities we are able to represent a diverse set of cultural heritage information not previously available through one source. This however also increases the complexity of the information storage and indexing for the system.

What is Digital Songlines Engine (DSE)?

DSE is a software development toolkit that combines many software applications into a new digital content assimilation technology for creating virtual heritage landscapes. The software toolkit provides content contributors and collaborators as well as communities a means for creating, managing and maintaining cultural heritage knowledge in a virtual world space.

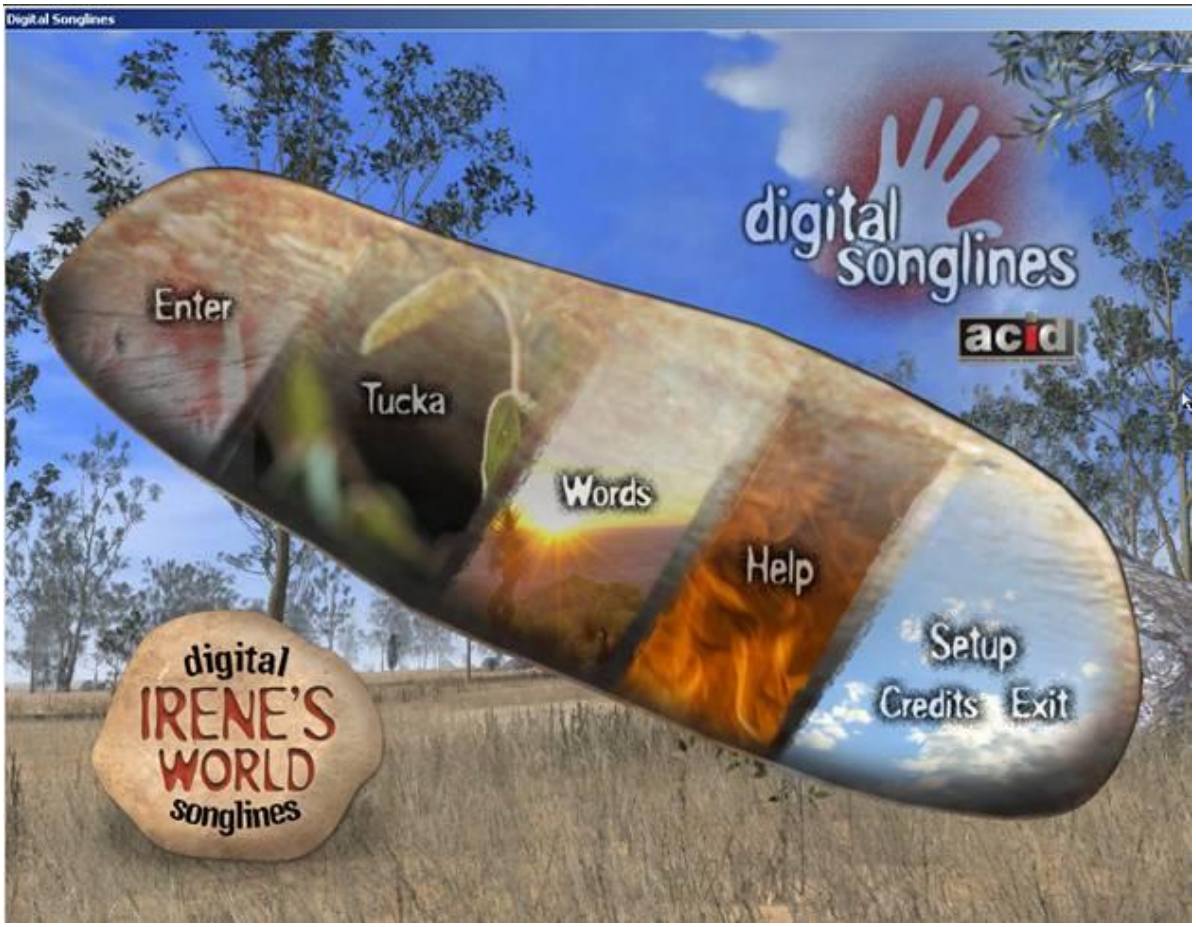
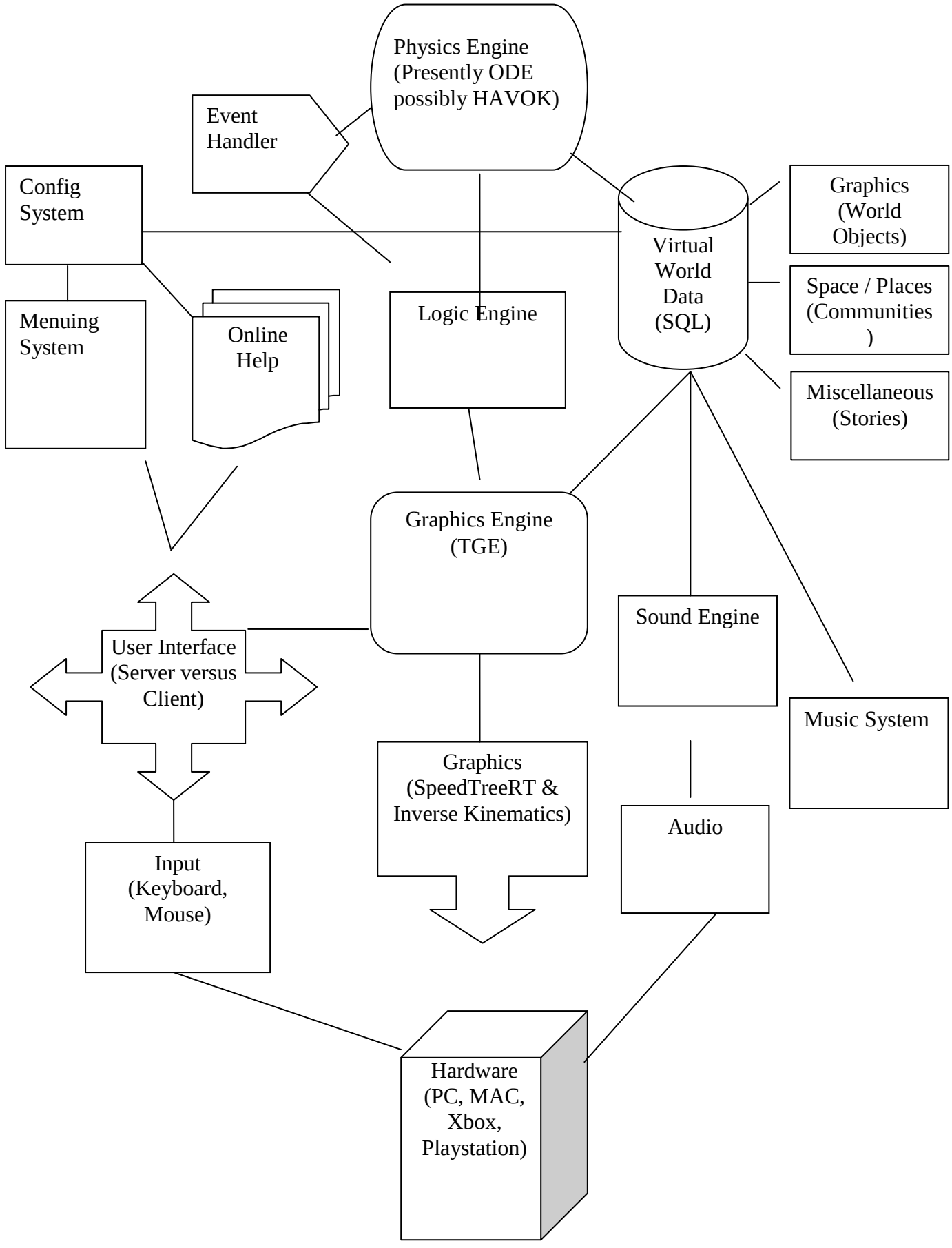


Image 7 *- Screen grab from Irene's World, a project designed in partnership with Irene Ryder and the Gunggari Community. This image shows the menu screen which presents options for the user to either enter, learn knowledge about bush foods, the Gunggari language, read help information, configure or optimise the system, read the credits of exit the system.*

Component Based Architecture of the Digital Songlines Engine



Physics Engine

Havok Physics, better known as simply Havok, is a middleware physics engine developed by Irish company Havok. It is designed for computer simulations to allow interaction between objects or other characters in real-time. In a dynamic simulation like DSE, Havok allows for more lifelike worlds and animation, such as ragdoll physics. The company recently released Havok Animation and Havok FX, which uses Shader Model 3.0 for NVIDIA and ATI GPUs for effects physics such as smoke, fire, water, dust, etc.

Logic Engine

The Logic Engine is a freeware systems integrated to phrase structure parsing, semantic-head-driven generation and constraint logic programming with typed feature structures and which allow type inheritance and appropriateness specifications for features and values. Arbitrary constraints may be attached to types, and types may be declared as having extensional structural identity conditions. Grammars may also interleave unification steps with logic program goal calls (as can be done in DCGs), thus allowing parsing to be interleaved with other system components. Most are developed with an eye toward Head driven Phrase Structure Grammar (HPSG), but it can also execute PATR-II grammars, definite clause grammars (DCGs), and LOGIN programs, etc. With additional features Logic Engines can also execute several aspects of Lexical Functional Grammar (LFG).

Graphics Engine

The open source community offers a number of graphics engines which are high performance real-time 3D engines written in C++ and available for.NET languages. A version of a graphics engine that the Aboriginal Communities team at ACID sought to integrate in DSE is Open Scene Graph which is completely cross-platform, uses D3D, OpenGL and incorporates its own software renderer. It has all of the state-of-the-art features found in most commercial 3D engines.

Event Handler

The event handler is an asynchronous callback subroutine which deals with inputs from programs. An event is a piece of application-level information from the underlying framework, for example the GUI toolkit. GUI events include key presses, mouse movement, action selections, and story sequences or video playback like Vincent's World. On a lower level, events represent availability of new data for reading a file or network stream – this is yet to be tested in DSE. Event handlers are a central concept in event driven programming – or digital storytelling.

Each event is created by a framework based on interpreting lower-level inputs, which may be lower-level events themselves. For example, mouse movements and clicks are interpreted as menu selections for the interaction design we've interpreted from user feedback in Virtual Warrane exhibit. Each event initially originates from a set of actions at the operating system level, such as interrupts generated by hardware devices, software interrupt instructions – we still had issues with respect how DSE would operate on ATI video cards. On this level, interrupt handlers and signal handlers correspond to event handlers.

User Interface and Input Devices

Graphical User Interfaces (GUI) accepts input via devices such as the computer keyboard and mouse to provide an articulated graphical output to the computer monitor. The user interface for DSE requires a special GUI design, which uses object oriented interfaces (OOUI) to be consistent with Aboriginal sensibilities and is culturally appropriate.

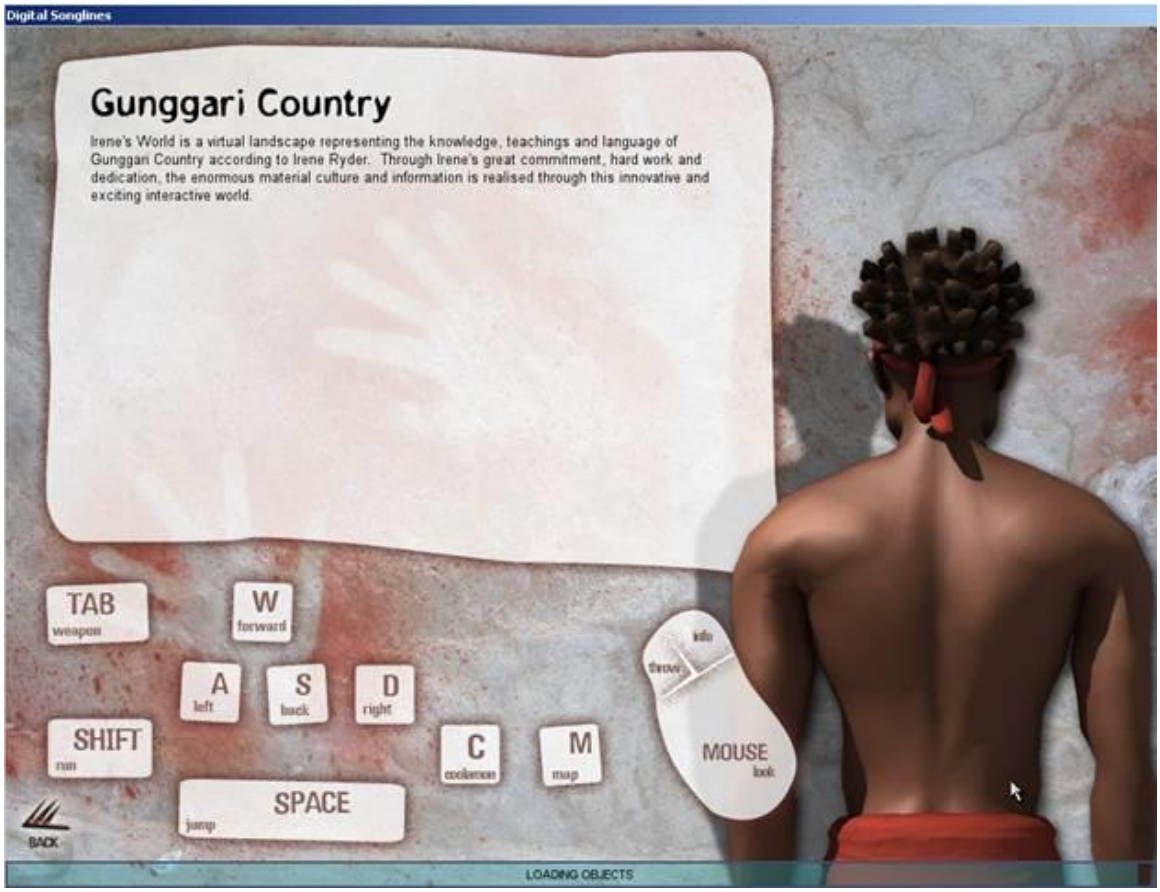


***Image 8** - A screen grab from Irene's World - a project designed in partnership with Irene Ryder and the Gunggari Community of South West Queensland. This image is of the loading screen with instructions on navigation of the 3D virtual heritage environment along with a brief introduction to the Gunggari country represent in this virtual heritage application.*

Web-based User Interfaces need to provide Aboriginal users of DSE, the ability to log in via a web page so that they can possess real-time control over the Virtual Environments and manage their content and access to the knowledge contained within.

Metadata System for Aboriginal Knowledge Management

The Metadata Library is intended as a repository for all the information gathered from the client throughout consultative process. There are several different open-formats available for cultural heritage data classification and storage. Existing formats (e.g. Dublin Core) are designed primarily as cataloguing systems for cultural heritage data. In this sense they are adequate for storing and retrieving information associated with real objects, places and stories.

The context in which the cultural heritage information gathered from the client is used – for the purpose of environment creation – is acutely different from the museums/library approach offered by existing metadata formats. The most significant difference is that we are capturing cultural heritage information that can be displayed in a game-engine; this implies that many of the objects generated within the database do not have unique physical appearance or location within the world.

Image 9 *- Screen grab from Irene's World, a project designed in partnership with Irene Ryder and the Gunggari Community. This image represents a 3D animation of a woman sharpening a digging stick and teaching a child sitting in a Yumba (shelter).*

As an example, a particular bird-call associated with a Dreamtime story has a cultural heritage context, but has a physical location and is unique to one particular community knowledge source and community group. Consequently, the database must be able to store a more specific metadata, rather than a general selection of computer files and judiciously associate the relevant virtual cultural heritage information to the relative item that is culturally significant.

Appendix A - Glossary of Terms & Acronyms

Artifacts *are the human-made objects, such as the tools, weapons or ornaments, especially that posses some significance from the perspective of cultural heritage values.*

Cultural heritage *is the legacy of physical artifacts and intangible attributes of a group, community or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations.*

Digital Elevation Model *(**DEM**) is a digital representation of the earth's surface, terrain, or topography. It is also be represented as **Digital Terrain Model** (**DTM**). For the purpose of DSE a DEM needs to be represented as a raster (a grid of squares) or triangular irregular network. Within DSE the use of DEMs assists in the positioning of significant objects or artifacts in a geographic information system (GIS) and is used for the basis of culturally specific placement of artifacts based upon the landscape relief and topography.*

Geographic Information Systems (GIS) *is a system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to the earth. In its application for AIVH it is applied as a system for integrating, storing, editing, analyzing, sharing, and displaying geographically in the DSE virtual heritage worlds. Adapted to DSE, GIS is a tool to allow users to create interactive queries or searches, analyse spatial information, edit data, label maps, and present knowledge in a 3D and spatially relevant and correct fashion.*

Global Positioning System *(**GPS**) is the uses the global navigation satellite system (GNSS) and a constellation of at least 24 medium earth orbiting satellites to transmit precise microwave signals, that enables a GPS receiver to determine its location, speed/direction and time on the earth's surface.*

Intellectual Property *(**IP**) is a term for various legal entitlements which attach to certain names, written and recorded media, and inventions. The holders of these legal entitlements may exercise various exclusive rights in relation to the subject matter of the IP which is a product of the mind or intellect. The term also implies that intellectual works*

are analogous to physical property and is in the domain of Aboriginal heritage is a matter of controversy.

***New media** is a form of human and media communication that have been transformed by the creative use of technology to fulfill the basic social need to interact and transact.*

***PGIS** is the result of a spontaneous merger of Participatory Learning and Action (PLA) methods with GIT&S. PGIS practice is based on using geo-spatial information management tools ranging from sketch maps participatory 3D model, aerial photography, satellite imagery, global positioning systems (GPS) and geographic information systems (GIS) to compose peoples' spatial knowledge in the forms of virtual or physical, 2 or 3 dimensional maps used as interactive vehicles for discussion, information exchange, analysis and as support in advocacy and decision making. GIS is used mainly as computer cartography with limited GIS functionality.*

***Torque Game Engine**, or **TGE**, is a modified version of a 3D computer game engine originally developed by Dynamix for the 2001. The Torque Game Engine has since been available for license from garage Games for independent and professional game developers and was chosen for use for the Australian Aboriginal Virtual Heritage (AIVH) discipline because of its cost and relative ease of use.*

***UNESCO** (**United Nations Educational, Scientific and Cultural Organization**) is a specialized agency of the United Nations established in 1945. Its stated purpose is to contribute to peace and security by promoting international collaboration through education, science, and culture in order to further universal respect for justice, the rule of law, and the human rights and fundamental freedoms proclaimed in the UN Charter.*

***Virtual Reality** (VR) is a technology which allows a user to interact with a computer simulated environment, be it a real or imagined one. Most current virtual reality environments are primarily visual experiences, displayed either on a computer screen or through special stereoscopic displays, but some simulations include additional sensory information, such as sound through speakers or headphones. Some advanced haptic systems now include tactile information, generally known as force feedback used in some gaming applications. Users can interact with a virtual environment or a virtual artefact either through the use of standard input devices such as a keyboard and mouse or through multi-model devices such as a wired glove or omni-directional treadmill. For the purpose of AVHI the simulated environment needs to be a faithful recreation of the*

real world and should differ significantly from this reality. The challenge of AIVH is to create a high fidelity virtual reality experience whilst working within the technical limitations, processing power of computers, and image resolution and communications bandwidth of the internet.

World Heritage Site** is a specific site such as a forest, hill, waterhole, lake, desert, rock art or massacre site that could be nominated for inclusion on the list maintained by the international World Heritage Program administered by the UNESCO **World Heritage Committee.

Appendix B – ACID Protocols Document

As a consultant to the Australasian CRC for Interaction Design(ACID), I was commissioned to researched and draft a set of protocols which would be adopted as guiding principles used in developing Aboriginal story treatments under ACID's Virtual Heritage Program. ACID eventually recognised these guidelines adapted from a number of papers as set down in the Queensland Cultural Heritage Act 2003. It saw these as a good framework to follow, with Duty of Care guidelines, to advise the project and its researchers in the development, progression and treatment of cultural heritage issues.

The fundamental principles are:
1. Seek ways and means to recognise, protect and conserve Aboriginal cultural heritage and do so on the basis of respect for Aboriginal knowledge, culture and traditional practices
2. Acknowledge Aboriginal people as the primary guardians, keepers, and knowledge holders of Aboriginal cultural heritage
3. Respect, preserve and maintain knowledge, innovations and practices of Aboriginal communities and seek collaborative ways to promote a greater understanding of Aboriginal heritage nationally and internationally;
4. Recognize the importance of and seek ways to protect and conserve Aboriginal cultural heritage in such a way as to allow Aboriginal people to reaffirm their obligation to "law and country"; and 5. Establish a methodology that is timely and efficient as a set of processes for the management of activities that will protect Aboriginal cultural heritage for present and future generations.

These principles are published on the ACID Indigenous Communities Project web site: http://songlines.interactiondesign.com.au/index.php?option=com_content&task=view&id=17&Itemid=82

The principles for dealing with Indigenous stories and narrative are:
1. That the stories of Traditional Owners be recognized as a 'body of knowledge' that may be tens of thousands of years old;
2. That the stories are sourced from the Traditional Owner who represents the country from which that story might originate;
3. That the communities make their own decision on what stories they want to have represented in Virtual Heritage;

4. That an approval process be implemented and approved by communities;
5. That the story represents the community and clan and is specifically placed geographically;
6. Ownership and copyright of the story is always held by the nominated Traditional Owner group or community council;
7. That the content of the Virtual Heritage application including artist styles is approved by the community at all key production stages;
8. That the story provided by the community is not modified unless approved and endorsed by the Traditional Owner representative of that community;
9. That the community be paid industry standard rates and receive royalties from revenue earned from any capitalisation or commercialisation;
10. That Indigenous people design and participate in the creation of the virtual Heritage application development at all stages of planning, design and production.

Other documents that inform ACID personnel and researchers are:
1. ABC Messagestick "Cultural Protocols for Indigenous Reporting in the Media"
http://abc.net.au/message/proper
2. "Writing Cultures: Protocols for Producing Indigenous Australian Literature" Australia Council for the Arts 2002 ISBN: 0 642 47240 8
http://www.austlit.edu.au/images/documents/WritingCultures.pdf
3. "New Media Cultures: Protocols for Producing Indigenous Australian New Media" Australia Council for the Arts 2002 ISBN: 0 642 47242 4
http://www.austlit.edu.au/images/documents/NewMediaCultures.pdf
4. "Visual Cultures: Protocols for Producing Indigenous Australian Visual Arts"Australia Council for the Arts 2002 ISBN: 0 642 47243 2
http://www.austlit.edu.au/images/documents/VisualCultures.pdf
5. "Song Cultures: Protocols for Producing Indigenous Australian Music" Australia Council for the Arts 2002 ISBN: 0 642 47239 4
http://www.austlit.edu.au/images/documents/SongCultures.pdf
6. "Performing Cultures: Protocols for Producing Indigenous Australian Performing Arts" Australia Council for the Arts 2002 ISBN: 0 642 47241 6
http://www.austlit.edu.au/images/documents/PerformingCultures.pdf
7. Veale, S., and Schilling, K. "Talking history: oral history guidelines." 2004 ISBN 1 74137 063 9.
http://nationalparks.nsw.gov.au/PDFs/Talking_History_Oral_History_Guidelines.pdf
8. Aboriginal Cultural Heritage Act 2003 (Qld) -
http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/A/AborCultHA03.pdf

9. Janke, T., and Quiggin, R., 2006. "Indigenous Cultural And Intellectual Property: The Main Issues For The Indigenous Arts Industry In 2006": Aboriginal and Torres Strait Islander Arts Board Australia Council.
http://www.ozco.gov.au/arts_resources/publications/icip/files/4059/icip.pdf
10. "Aboriginal Cultural Heritage Standards & Guidelines Kit": NSW National Parks and Wildlife Service.
http://www.nationalparks.nsw.gov.au/PDFs/aboriginal_heritage_guidelines_kit_final.pdf
11. Poole, P., 2003, "Cultural Mapping And Indigenous Peoples" A report for UNESCO: UNESCO.
http://portal.unesco.org/culture/fr/file_download.php/d22493032689ffd56863f4124ce6625ecultural_mapping_1.pdf

Appendix C - Annotated Bibliography

Websites

http://www.evl.uic.edu/cavern/

This link is for the Electronics Visualisation Laboratory at the University of Illinois in Chicago. There major goal is to create a persistent virtual environment that enables multiple users across the world to network over high-speed and high-bandwidth networks via heterogeneous supercomputing resources with very large databases. The University has conducted many project s related to a concept known as Tele-immersion. Their website covers topics like:

- *OptIPuter*
- *Continuum Project*
- *GeoPad*
- *AGAVE*
- *CAVERN*
- *The Virtual Harlem Project*
- *CAVEGui*
- *Human Factors in Tele-Immersion*
- *QoSIMoto*
- *CIBR View*
- *TIDE*
- *Tandem*
- *Round Earth Project*
- *N.I.C.E*
- *CALVIN*
- *CASA*

http://www.virtualworldheritage.org

This website is the home for the United National Educational, Scientific and Cultural Organisation. It represents the 30th Anniversary Virtual Congress for the World Heritage Centre or UNESCO.

http://www.virtualheritage.net

Virtual Heritage Network is an international organisation whose role is to promote the utilization of technology for the education, interpretation, conservation and preservation of natural, cultural and World Heritage. The network is a physical and electronic network of people and resources in many countries currently working in the Virtual Heritage community. This organization has been formed through the ideas of people working in the heritage and technology industry that recognise that the need to further collaboration in this important subject.

http://www.digicult.info/

Digicult is an organization that works in the cultural heritage industry. They say their role is to as monitor and assess existing and emerging technologies that provide opportunities to develop, improve access to, and preserve Europe's rich cultural and scientific heritage, within the emerging digital cultural economy.

http://www.heritage.gov.au/

This is the website to Australia's cultural heritage peak government body.

http://migrationheritage.nsw.gov.au/toolkit/

The role of the Migration Heritage Organization is to avoid taking an institutional direction that often museum adopt and work with ethnic communities, the cultural and education sectors, local, state and commonwealth governments and businesses to develop and realize projects dedicated to the recognition and promotion of the cultural heritage of NSW.

Virtual Heritage Project Websites

http://www.docm.mmu.ac.uk/RESEARCH/virtual-museum/Menna/report.pdf
This paper was written in 1996 and its project explores the use of VRML to reconstruct historical monuments for easy access over the web. The paper seeks to document potential uses for education, virtual heritage and archaeological visualization. It also documents potential threats and damage that tourism might have upon significant suites and who people might support and encourage tourism whilst in particular preserving the sites of Theban Tombs near Luxor in Egypt.

http://www.miralab.unige.ch/3research/research_project.cfm?projectid=The_Xian_Terra_Dcotta_Army
This is the website of MIRA Lab of the University of Geneva. They have assembled a team of researchers to explore human functionality for simulation and realistic applications. They blend computer science, electrical engineering, multimedia, virtual environments anthropometric body modeling and psychology for the creation of virtual human simulations and virtual worlds.

http://www.fhw.gr/fhw/en/projects/3dvr/
This is the website of the Foundation for the Hellenic World. The foundation is a not-for-profit cultural institution based in Athens, Greece. The foundation uses state-of-the-art, cutting edge information and computer technology in its pursuit of the research, awareness and understanding of Hellenic history and culture.

http://www.evl.uic.edu/cavern/papers/igrid-heritage2001.pdf
This research paper explores the possibility of using a combination of high-speed networks for cultural heritage education for the purpose of creating immersive classrooms and virtual heritage displays.

http://www.cineca.it/editions/ssc2001/213.pdf
The Nu.M.E. Project is a created virtual environment of Bologna that permits visitors an opportunity to explore a web based virtual environment. They also classify their display as virtual theatre and incorporate a timeline that allows user to explore any period in the history of Bologna driving at street level or flying at the roof tops. They call their time bar a temporal navigation tool.

http://www.cs.brown.edu/research/graphics/research/sciviz/archaeology/archave/index.html
The ARCHAVE system was created to assist in the evaluation of user interaction in virtual reality environments and to build data visualization techniques for scientific applications. Users and developers of ARCHAVE are theoretically able advance archaeological and its computational aspect in the heritage and archaeology. It is said that users now have a better understanding of the possibilities of virtual heritage and developers can apply this is a new and technically untried manner.

http://www.brunel.ac.uk/project/murale/home.html
An international team of multimedia developers with the support of the Brunei University and financial assistance of the European Union are collecting developing new 3D multimedia tools that measure, reconstruct and visualize archaeological ruins of Sagalassos in Turkey. The site at Sagalassos is one of the largest archaeological

projects in the Mediterranean dealing with a Greco-Roman site over a period of more than a thousand years (4th Century BC - 7th Century AD).

http://www.camtech.ntu.edu.sg/research/heritage.htmThis website about the Centre of Advanced Media Technology is a project that aims to recreate part of the Peranakan Culture Heritage in Singapore using Virtual Reality. The major aim is to find new ways for interaction within a heritage environment.

Virtual Heritage Toolkit Websites
http://www.charismatic-project.com
Charismatic's objective is to develop essential technologies required to establish a new tourism industry, exploiting Europe's unique position in Global Cultural Heritage by combining the heritage subjects with real-time technologies. The project combines research from two previously distinct areas in modeling sites of cultural importance and recreating people and events using advanced virtual humans. Charismatic project brings together the technologies of Virtual Reality, 3D visualisation and intelligent avatars in order to offer to create a professional and entertaining way to enjoy heritage as well as preserve it.

http://wscg.zcu.cz/wscg2003/Papers_2003/E23.pdf
This paper explored experimentation of a generic framework for architecture heritage data visualization.

http://www.miralab.unige.ch/subpages/lifeplus/
This website is about using innovative 3D reconstruction of ancient fresco-paintings through the real-time revival of their fauna and flora and avatar using dramaturgical behaviours in an immersive environment.

http://www.eurasian-dhx.org/
This website relates to the DHX (Digital Ecological and Artistic Heritage Exchange) project. This project has the main aim of establishing a networked virtual reality infrastructure and content development environment for museums and cyber theatres, for mutual exchange of digital cultural and natural heritage. A number of European and Asian partners are participating for transcontinental shared immersive experience in a global scale using high-bandwidth Trans-Euro-Asian networks.
http://www.photogrammetry.ethz.ch/general/persons/jana/daressalaam/papers/Ruther.pdf
This paper relates to African Heritage and is a virtual preservation project relating to Africa's past.

http://www1.cs.columbia.edu/~allen/ITR/
This website describes a project where the National Science Foundation was awarded a grant to explore the development of new computational tools for modelling, visualizing, and analyzing historic structures and archaeological sites. The tools are being developed with archaeologists and tested at a site in Egypt's Western Desert as well as the St John Cathedral in New York. The third test bed is the Cathedral of Ste. Pierre in Beauvais, France.

http://www.archaeologie-wien.at/caa2003/topics/16.htm
This page is a link to various visualization techniques for virtual heritage including titles like computer games and archaeological reconstruction, charismatic approaches to modeling and rendering of historical urban environments and photorealistic 3D modelling of a Byzantine crypt.

http://www.virtualstorytelling.com/

This website relates to the 2nd International Conference on Virtual Storytelling held in Toulouse, France. This international conference saw researchers from the scientific, artistic and industrial communities demonstrate new methods and techniques, presenting their results and exchanging ideas on how best to use Virtual Reality technologies to create, populate, render and interact with stories, be they in the form of theatre, movie, cartoon, advertisement, puppet show, multimedia work or video-games.

http://godot.unisa.edu.au/wac/
This website contains a database of all papers received by the University of South Australia on Aboriginal Culture and Heritage.

http://research.cs.vt.edu/3di/publications.html
This website is another database of research paper relating to virtual reality and heritage given at conferences or simple journal articles.

Virtual Heritage Organizations and Special Techniques Websites
http://www.hitl.washington.edu/
This website represents the Human Interface Technology Laboratory in Washington, the big brother of the HIT Lab in New Zealand. This Centre was established in 1989 by the

Washington Technology Centre (WTC) to transform virtual environment concepts and early research into practical, market-driven products and processes. The HITL research strengths relate to ACID in that they explore interface hardware, virtual environments software, and human factors.

http://www.hitl.washington.edu/scivw/IDA/
This website dictates a report that reviews current interface technology for use in virtual environments back in 1996. It describes visual tracking, auditory, primary user input (including, for example, glove, body suit, exoskeleton, track ball, and 3-D mouse inputs), tactile, kinaesthetic, full-body motion, and olfactory interface technologies. This abstract explores what relevant human capabilities are for making available commercial products and ongoing research and development. Why the information on this website is good is that it was originally used as the basis for predicting how virtual environment interfaces were likely to change over the five years – so in following their hypotheses we can see how close they were to predicting future reality.

http://www.mic.atr.co.jp/~poup/3dui/resource.htm
This website is a 3D UI mailing list and website that covers the topics of computer graphics, user interfaces, software engineering, psychology, human factors, art & design. In their terms 3D UI is rapidly growing and this site encourages a discussion an exchange by researchers and practitioners in these various fields.

http://graphics.stanford.edu/projects/mich/
This website explores how recent improvements in laser rangefinder technology, together with algorithms developed at Stanford University combines multiple range and colour images to allow developers to reliably and accurately digitize the external shape and surface characteristics of many physical objects. Their examples include digitalization of machine parts, cultural artefacts, and design models for the manufacturing, moviemaking, and video game industries.

http://www.sculptor.org/3D/Scanning/imaging.htm
This website describes a tool that is a capture device and application for taking 3D human form into cyberspace for economic benefit and entertainment value. Their technology is supposedly a leading-edge one that can digitally capture the human form in 3D using a technique known as Digital Surface Photogrammetry (DSP). Their

approach is to project random light patterns on the subject and capturing them with precisely synchronized digital cameras set at various angles. By filtering different wavelengths of light a 3D surface geometry and surface texture can be acquired simultaneously, resulting in a very accurate texture map when applied to the surface data. With the capability of 144 digital cameras shuttering simultaneously their scalable capture systems can overlap the random light pattern to let someone digitally capture a full 360° view of the subject in a single shot. They argue that the scalability they offer is not possible with other techniques including structured light patterns. Their technology has capture times as low as 0.002 seconds.

http://www.cc.gatech.edu/gvu/virtual/index.html
This is the website of the Virtual Environments Group of Georgia Tech. Their project is to create and study immersive computer-generated experiences using software system support for virtual environments, three-dimensional human-component interaction, and applications of virtual reality to clinical psychology, education, and visualization.

http://www.terrainmap.com/
Terrainmap is a digital terrain modelling technique using data SDTS, DRG, DLG, DTED, ASTER, Landsat, EarthSat and EarthKam data. From this data this organization claims to generate 3D digital terrain maps using free digital elevation model (DEM) data from USGS, NIMA, ASTER or Landsat sources. Last updated May 2, 2004.

http://www.ai.sri.com/TerraVision/
This website is about TerraVision™ is an open source distributed, interactive terrain visualization system developed by SRI International. Their software allows users to navigate, in real time, through a 3-D graphical representation of a real landscape created from elevation data and aerial images of that landscape. Supposedly there are a number of terrain visualization tools on the market, but this source states that they can browse a dataset in the terabytes, distribute data across servers, overlay GeoVRML and 3D VRML models, access OGC web map servers and permit different size, resolution and source details.

Reports on Aboriginal Arts, Culture and Heritage

Aboriginal and Torres Strait Islander Protocols for Libraries, Archives and Information Services, Aboriginal and Torres Strait Islander Library Services, 1999.

Janke, T. 2002. Our Culture, Our Future, Report on Australian Aboriginal Cultural and Intellectual Property: Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS).

Bell, S. 1997. Arts, Business Culture: a Research Report on an Aboriginal Cultural Industry in Queensland: Arts Queensland.
This reports represented two years of work by Research Officer Sharenne Bell under a Steering group of Aboriginal and non-Aboriginal people who were committed to achieving positive outcomes for Aboriginal and Torres Strait Islander Artists and Communities throughout Queensland. The Steering Committee included Chairperson Wayne Coolwell, John Anderson, Professor Tony Bennett, Glen Miller, Isabel Tarrago and Trish Vysma. The report made 30 recommendations that formed the basis of the policy of Queensland on an Aboriginal Arts Strategy.

Bostock, L. 1997. Greater Perspectives - Protocols for Production of Film, Television on Aboriginal and Torres Strait Islander People: SBS.

Cooper, J., Molnar, H., Morris, C. and Colbert, M. 2000. To Tell My Story: A Study of

Practicing Professional Indigenous Writers of Australia: Aboriginal and Torres Strait Islander Arts Board of the Australia Council.
This report was a study of Aboriginal writers and storytellers commissioned by the Aboriginal and Torres Strait Islander Arts Board of the Australia Council. This report considered the characteristics and geographical distribution of Aboriginal Writers, education and training issues, work conditions and employment, financial circumstances, career development opportunities, achievements and outputs, women writers, and the funding situation.

DATSIP, 1998. Mina Mir lo Ilan Ma: Department of Aboriginal and Torres Strait Islander Policy.

DATSIP, 1998. Protocols for Consultation with Aboriginal People. Department of Aboriginal and Torres Strait Islander Policy.

Mellor, D. & Janke, T. 2001. Valuing Art, Respecting Culture: Protocols for Working with the Australian Indigenous Visual Arts and Craft Sector: Aboriginal and Torres Strait Islander Arts Board of the Australia Council.
This report provides a brief overview of Aboriginal and Torres Strait islander Environments in Australia and comments on the development of the Aboriginal visual arts sector over the past few decades and outlines a set of protocol guidelines. This report explores the legal issues for visual arts sector and how the Australian Law fails to address these circumstances. It also suggests that no provisions are made for ethical or responsible dealings with Aboriginal cultural matters. This research is an introduction into more in depth protocol development.

Taking the Time, Museums, Galleries, Cultural Protocols and Communities. Museums Australia, 1998.

Valuing Art, Respect Culture - Protocols for Working with the Australian Aboriginal Visual Arts and Craft Sector. National Association for the Visual Arts, 1998.

Books on Aboriginal Arts, Culture and Heritage

Glogoff, S. 2001. Virtual connections: community bonding on the Net. First Monday , 6 (3): 1 page. http://www.firstmonday.org/issue6_3/glogoff/index.html (accessed November 20, 2003).

O'Brien, J. 1994. Management . Sydney : Prentice Hall.

Bickford, A. 1987. Aborigines in New South Wales after 1788: Publisher.
In the past, Australian history has been split by revelations by contact historians of the strength and resilience of the Aboriginal response to white invasion. This article examines historical evidence put forward by such historians whom illustrate the struggle of Aborigines in New South Wales to survive despite their conquest and subsequent control by whites. Various contact sites of heritage significances such a the Myall Creek Massacre, the native Institute at Parramatta and missions set up by Churches in the interior of New South Wales are used to illustrate the Aboriginal / European history of New South Wales.

Blake, T. 1998. Departed…at the Sweet Will of Government: The Removal of Aboriginal to Reserves in Queensland 1897 – 1939: Publisher.
The Aboriginal Protection and Restriction of the Sale of Opium Act was introduced into Queensland parliament in 1897. In this act under section 9, the Minister was given authority to remove Aboriginal people from fringes and elsewhere and move them onto

reserves. After four decades nearly 7,000 Aborigines had been forcefully moved as a result of action undertaken in the following of this legislation. Major settlements where established in places like Barambah, Worrabinda, Cherbourg, Aurukun, Leichardt River, Wujal Wujal, Hopevale and many other places. Some of these locations are now Deed of Grant in Trust areas (DOGIT) and are managed by Aboriginal people under Local Council By-laws. However the impact and destruction that this practice had is still being felt today.

Byrne, D. 2003. The Ethos of Return: Erasure and Reinstatement of Aboriginal Visibility in the Australian Historical Landscape: Publisher.
Segregation in society is evidenced across Australia between Aboriginal People and the broader society for hundreds of years. There is some research that explores the spatial patterns of life in Aboriginal society after invasion and how lack of infrastructure and the reserve system has not just limited social, economic and political development of Aboriginal People but also contributed to the decline of the culture.

Casey, M. 2004. Creating Frames: Contemporary Indigenous Theatre: Publisher.
This book provides a significant social and cultural history of Aboriginal Theatre across Australia. It explores archival sources and national and Independent theatre company records as well as interviews with such theatre legends as Bob Maza, Jack Charles, Gary Foley, Justine Saunders, Wesley Enoch, Ningali, and John Harding. For nearly three decades, Aboriginal Theatre has negotiated a path through apartheid, assimilation and multiculturalism towards the documentary of Aboriginal lives and opening the way for careers through this medium of expression.

Cook, W. 1986. Aboriginal Involvement in Archaeology: Publisher.
In New South Wales, Aboriginal people have some control over archaeological study of their ancestors. Subjects covered include Aboriginal Archaeology, Administration and participation.

Elkin, A.P. 1953. The Australian Aborigines: Publisher.

Elder, B. 1988. Blood on the Wattle: Publisher.
This book is an account of the massacres, maltreatment and spread of the white men's diseases that resulted in the deaths of many thousands of Australian Aborigines. It is descriptive and dramatic account of these events that is not intended to be an exercise in retrospective guilt association but aims to accurately document an integral part of Australia's history. This book describes European settlement impacts upon Aboriginal sites of significance as well.

Henderson, J. 1997. Culture and Heritage: Indigenous Languages: Pulisher.
Henderson argues that cultural expression is best presented and represented in language thus allow the best possible practice, transmission and expression of knowledge across generations. His paper explores Aboriginal languages across Australia up to 1995 and in his research depicts the disastrous decimation of languages through European colonization and conquest. His major point is that the loss of Aboriginal language is the loss of traditional knowledge. In any exploration of significant Aboriginal places he suggests combining this with narrative context and related songs and performance, begging the question that language knowledge is essential. His paper further summaries the pressured need to repatriate language and ensure their ongoing survival.

Langloh Parker, K. 1953. Australian Legendary Tales: Angus and Robertson.
Katie Langloh Parker collected a vast number of Dreamtime Tales of the Euahayi People around the Narran River in 1890s. These objective and non anthropological stories

relate mostly to the legends, myths, drawings, star clusters, elements, environment and culture of a people who today continue to argue for their association to the country that is the origin of these tales.

Meehan, B. 1995. Aboriginal Views on the Management of Rock Arts Sites in Australia: . Meehan delivered this paper at the Alta Conference on Rock Art in Oslo, Norway in 1995. In his presentation he presents that Aboriginal people believe that their ancestors didn't travel to Australia, but they were always here since the Dreamtime. He states that the attitude of Aboriginal people to rock arts is complex and cites proof form oral traditions within Native Title hearings. He goes on to say that Aboriginal people have a deep attachment to art and culture.

Memmott, P. 1991. Humpy, House and Tin Shed: Aboriginal Settlement History on the Darling River: Queensland University Press.
This study is a case study that documents historical developments of the Aboriginal people coming into the town of Wilcannia to settle. It analyses the social framework by which tribal nomadic or settled Aboriginal live on the fringes of towns and outstations and the patterns of housing form that this dictates. This is relevant to exploring who settlement patterns might have been along the Murray/Darling Catchment Area of which Wilcannia is a part as well as the cultural shift that modern society brought upon the Aboriginal people.

McKellar, H. 1996. Matya Mundu: A History of the Aboriginal People of South West Queensland: Queensland University Press.
The Aboriginal tribes of south west Queensland are closely related to each other and share many customs and beliefs. The tribes include the Badjari, Bidjara, Gungarri, Kooma, Kunja, Kullilla and Mardagany. This book documents the history and associations in each tribe and adds a few simple genealogical charts. The book recounts the personal histories of Aboriginal people living on the fringes of Cunnamulla, Eulo, and Thargomindah.

Skulthorpe, T. 1998. Aboriginal Involvement in Northern Land & Water Management: Murray-Darling Basin Commission.
This study covered the lands around the Narran-Culgoa floodplain, including the rivers of Narran, Biri, Bokhara and Culgoa. The area around the Narran is traditionally the Noonghal country of the Noongaburra people. This study had a major purpose of improving the involvement of local Aboriginal people in the land, water and resource management of the area and involved the relating of traditional stories and old style land and water management rights and practices. This report includes a VHS tape as well.

Ridgeway, A, D. 1984. Aboriginal Sites and Involvement of Aborigines in Management and Interpretation: NSW National Parks and Wildlife.
This paper argues that Aboriginal people must be involved in the protection, preservation, management and interpretation of Aboriginal sites. The implementation of the policy of the New South Wales National Parks and Wildlife Service to include Aborigines in the protection and preservation of Aboriginal sites is explored. A case study of Lake Mungo is presented by Aden.

Rose, D.B. 1987. Biographical Ecological Maps:
This author outlines a successful method of Interviewing Aboriginal people for research into their relationship with their environment. The aim is to map people's early travels and record details of the food, medicinal, technological resources and water resources. Vast amounts of information have been produced and mapping of the past environment is made easier by this collection of working methods.

Sommerville, C. 2003. Cultural Importance of Rock Art to Today's Aboriginal People:. Aboriginal people have been engaged in Rock Art for over 60,000 years. Many would argue this is a present day link to Aboriginal history and the Dreamtime. It is an expression of the land and the role of Aboriginal people in preserving the memory of their ancestors and their custodial association with country. Somerville argues for the need to consult with the Appropriate Aboriginal people and to respect their views on their culture and heritage regarding this issue.